

# Relating Business Goals to Architecturally Significant Requirements for Software Systems

Paul Clements  
Len Bass

**May 2010**

**TECHNICAL NOTE**  
CMU/SEI-2010-TN-018

**Research, Technology, and System Solutions Program**  
Unlimited distribution subject to the copyright.

<http://www.sei.cmu.edu>



This report was prepared for the

SEI Administrative Agent  
ESC/XPB  
5 Eglin Street  
Hanscom AFB, MA 01731-2100

The ideas and findings in this report should not be construed as an official DoD position. It is published in the interest of scientific and technical information exchange.

This work is sponsored by the U.S. Department of Defense. The Software Engineering Institute is a federally funded research and development center sponsored by the U.S. Department of Defense.

Copyright 2010 Carnegie Mellon University.

#### NO WARRANTY

THIS CARNEGIE MELLON UNIVERSITY AND SOFTWARE ENGINEERING INSTITUTE MATERIAL IS FURNISHED ON AN "AS-IS" BASIS. CARNEGIE MELLON UNIVERSITY MAKES NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, AS TO ANY MATTER INCLUDING, BUT NOT LIMITED TO, WARRANTY OF FITNESS FOR PURPOSE OR MERCHANTABILITY, EXCLUSIVITY, OR RESULTS OBTAINED FROM USE OF THE MATERIAL. CARNEGIE MELLON UNIVERSITY DOES NOT MAKE ANY WARRANTY OF ANY KIND WITH RESPECT TO FREEDOM FROM PATENT, TRADEMARK, OR COPYRIGHT INFRINGEMENT.

Use of any trademarks in this report is not intended in any way to infringe on the rights of the trademark holder.

Internal use. Permission to reproduce this document and to prepare derivative works from this document for internal use is granted, provided the copyright and "No Warranty" statements are included with all reproductions and derivative works.

External use. This document may be reproduced in its entirety, without modification, and freely distributed in written or electronic form without requesting formal permission. Permission is required for any other external and/or commercial use. Requests for permission should be directed to the Software Engineering Institute at [permission@sei.cmu.edu](mailto:permission@sei.cmu.edu).

This work was created in the performance of Federal Government Contract Number FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center. The Government of the United States has a royalty-free government-purpose license to use, duplicate, or disclose the work, in whole or in part and in any manner, and to have or permit others to do so, for government purposes pursuant to the copyright license under the clause at 252.227-7013.

---

# Table of Contents

|   |             |
|---|-------------|
| <b>Acknowledgments</b>                                      | <b>viii</b> |
| <b>Executive Summary</b>                                    | <b>x</b>    |
| <b>Abstract</b>   | <b>xiv</b>  |
| <b>1 Introduction</b>                                       | <b>1</b>    |
| 1.1 The Requirements/Architecture Mismatch                  | 1           |
| 1.2 Business Goals Beget Quality Attributes                 | 1           |
| 1.3 Terminology   | 3           |
| 1.4 Purpose   | 3           |
| 1.5 Organization of this report                             | 4           |
| <b>2 Classifying Business Goals</b>                         | <b>5</b>    |
| 2.1 Eschewing a Taxonomy                                    | 5           |
| 2.2 Synthesis of Business Goal Categories                   | 5           |
| 2.3 The Goal-Subject of Business Goals                      | 10          |
| 2.4 The Goal-Object of Business Goals                       | 11          |
| 2.5 Summary of This Section                                 | 13          |
| <b>3 Expressing Business Goals</b>                          | <b>15</b>   |
| 3.1 Related Work: TOGAF Business Scenarios                  | 15          |
| 3.2 Related Work: Goal-Oriented Requirements Engineering    | 16          |
| 3.3 Business Goal Scenarios                                 | 17          |
| 3.4 A General Scenario for Business Goals                   | 19          |
| 3.5 A Document Summarizing Business Goals                   | 21          |
| <b>4 From Business Goals to Quality Attributes</b>          | <b>23</b>   |
| 4.1 PALM  | 23          |
| 4.2 Validating the Method                                   | 24          |
| 4.3 Piloting the Method                                     | 25          |
| <b>5 Conclusions</b>  | <b>27</b>   |
| <b>Appendix – Survey of Literature on Business Goals</b>    | <b>29</b>   |
| A.1 Cross-National Business Goals                           | 29          |
| A.2 Ethical versus Self-Interest Goals                      | 30          |
| A.3 Business Goals for CEOs                                 | 31          |
| A.4 Marketing Strategies                                    | 32          |
| A.5 What Drives Business Models                             | 33          |
| A.6 An Ontology for Business Models                         | 34          |
| A.7 Assessing Technology Risk                               | 36          |
| A.8 Seven Key Elements of a Business Model                  | 37          |
| A.9 Stakeholder Theory                                      | 38          |
| A.10 Changing Business Models Can Define an Industry        | 40          |
| A.11 Business Goals Collected from Architecture Evaluations | 41          |
| A.12 Business Goals in a Multi-Project (Portfolio) Context  | 42          |
| A.13 Project Types Influence Business Goals                 | 43          |
| A.14 Enterprise Architecture and TOGAF                      | 45          |

|                              |           |
|------------------------------|-----------|
| A.15 Summary of This Section | 46        |
| <b>References</b>            | <b>49</b> |

---

## List of Figures

|            |  |    |
|------------|--|----|
| Figure 1:  | Corporate Goals Should Drive Project Goals [Morris 2005]   | 2  |
| Figure 2:  | Some Business Goals May Lead to Quality Attribute Requirements (Which Lead to Architectures), or Lead Directly to Architectural Decisions, or Lead to Non-Architectural Solutions. | 3  |
| Figure 3:  | Partington's Three Levels of Strategy [Partington 2000]  | 10 |
| Figure 4:  | TOGAF Template for Documenting a Business Scenario   | 16 |
| Figure 5:  | Schema for Goals [Antón 1997]  | 17 |
| Figure 6:  | Contents of a Business Requirements Definition [Partington 2000]   | 21 |
| Figure 7:  | Fifteen Important Business Goals [Hofstede 2002]   | 30 |
| Figure 8:  | List of Business Goals Discriminated by Self-Interest versus "Other"-Interest [Usunier 2008]   | 31 |
| Figure 9:  | Fulmer's Business Goals [Beggs 1989]   | 32 |
| Figure 10: | Drivers of Business Model Change [de Reuver 2007]  | 34 |
| Figure 11: | Business Models Lie at the Intersection of Strategy, Organization, and Technology [Osterwalder 2004]   | 35 |
| Figure 12: | The Ontology Definition for Value Proposition and Offering [Osterwalder 2004]  | 36 |
| Figure 13: | An Example of a Value Proposition for a Firm's Offerings   | 36 |
| Figure 14: | Example of Matrix to Help Determine Technology Risk Factor [Bodde 2007]  | 37 |
| Figure 15: | Input-Output Model of a Corporation [Donaldson 1995]   | 38 |
| Figure 16: | Stakeholder Model of a Corporation [Donaldson 1995]  | 39 |
| Figure 17: | Key Constructs in Mitchell and Colleagues' Stakeholder Theory [Mitchell 1997]  | 40 |
| Figure 18: | Summary of Telecom Industry Survey Results [McIntosh 2007]   | 41 |
| Figure 19: | Projects Can Be Classified by How Much They Change Existing Products and Processes [Wheelwright 1992, Artto 2007]  | 45 |



---

## List of Tables

|          |  |    |
|----------|--|----|
| Table 1: | Synthesized Business Goal Categories                 | 6  |
| Table 2: | Business Goals and Their Goal-Objects                | 12 |
| Table 3: | General Scenario Generation Table for Business Goals | 20 |
| Table 4: | Business Goal Categories from Bass and Kazman        | 42 |
| Table 5: | Summary of Related Work                              | 46 |







---

## Acknowledgments

We gratefully acknowledge the support of our Software Engineering Institute management for giving us the opportunity to pursue this investigation. Thanks to Sheila Rosenthal of the SEI Library whose research into works on taxonomies and classifications of business goals provided an invaluable foundation for this work. Carolyn Kernan of the SEI extracted the business goal / quality attribute information from our archive of previous ATAM results. Thanks to Klaus Schmid of the University of Hildesheim (Germany), whose course in requirements engineering helped us uncover Porter's work in marketing strategies. Thanks to Rick Kazman for helping to create the structure of business goal scenarios. Thanks to Linda Northrop for a helpful and thorough review. Thanks to Claire Dixon for a fine job of editing.

Rolf Siegers, Joe Batman, Don O'Connell, Joseph DelGaudio, Mike Gagliardi, Rick Kazman, and Mark Klein provided helpful reviews of earlier drafts. Rolf Siegers pointed out the connection to business scenarios in TOGAF. Don O'Connell helped to clarify some of the steps of the Pedigreed Attribute eLicitation Method (PALM) and to arrange a pilot offering. Eltjo Poort reminded us of the goal-oriented requirements engineering work, which was a fruitful connection. John Bergey helped us align our terms with DoD terminology.

We are particularly appreciative to the participants of our two April 2009 workshops, in Pittsburgh and in Amsterdam, which gave us forums for presenting our ideas and receiving useful feedback. We especially thank Eltjo Poort of Logica who organized and hosted the European workshop. Finally, we would like to thank the people at Boeing Air Traffic Management who participated in the PALM pilot that we describe in the report.



---

## Executive Summary

### Requirements-Architecture Mismatch

The study of the principles and practices needed to produce a high-quality software architecture constitutes a rich and productive field of investigation, pursued vigorously by the Software Engineering Institute (SEI) and others. However, that field has almost completely overlooked an inconvenient truth:

*There is a deep and fundamental mismatch between the information that requirements specifications contain and the information that architects need.*

This mismatch manifests in two ways:

1. Most of what is in a requirements specification does not determine or “shape” an architecture. Architectures are mostly driven or shaped by quality attribute requirements. These determine and constrain the most important architectural decisions. And yet the vast bulk of most requirements specifications is focused on the required features and functionality of a system, which shape the architecture the least. Worse, most do a poor job of specifying quality attributes; many ignore them altogether.
2. Much of what is useful to an architect is not in even the best requirement specification. Many concerns that drive an architecture do not manifest as observables in the system being specified and so do not appear in requirements specifications. These often derive from business goals in the development organization itself, such as keeping people productively employed, amortizing investments in existing tools and technologies, satisfying human resource concerns, improving the organization’s market position relative to its competition, and others.

### Business Goals Beget Quality Attributes

We take as an axiom that every quality attribute—such as user-visible response time or platform flexibility or ironclad security or any of a dozen other necessities—originates from some higher purpose that can be described in terms of added value.

This relationship between corporate goals and project goals seems self-evident, but it is apparently not well understood in the business literature.

### Purpose

Our purpose is to facilitate better elicitation of high-pedigree quality attribute requirements. Toward this end, we want to be able to elicit business goals reliably and understand how those business goals influence quality attribute requirements and architectures.

The elicitation approaches outlined in this report can be used by requirements engineers who want to produce a set of requirements helpful to the software architect; by parties such as those running an SEI Quality Attribute Workshop [Barbacci 2003]; or by the architect when nobody else has produced such requirements.

## Classification of Business Goals

Based on an extensive literature survey, we were able to produce a classification for a large number of common business goals. The classification categories are

- Maintaining growth and continuity of the business
- Meeting the company's financial objectives
- Meeting personal objectives
- Meeting responsibility to employees
- Meeting responsibility to society
- Meeting responsibility to country
- Meeting responsibility to shareholders
- Managing market position
- Improving business processes
- Managing quality and reputation of products

## Managing Change

Within these categories, the literature also makes clear that changes in the environment must also be managed. The categories of the environment that the literature identified as important to manage are the social environment, legal and regulatory environment, competitive environment and technological change, and customer environment.

## Business Goal Scenarios

The purpose of business goal scenarios is to ensure that all business goals are expressed clearly, in a consistent fashion, and contain sufficient information to enable their processing through the further steps of our technique.

A business goal scenario has six parts:

1. **Goal-subject.** This is the stakeholder that owns the goal. The stakeholder may be an individual, an individual in an identified organization if more than one organization is in play, or (in the case of a goal that has no one owner and has been assimilated into an organization) the organization itself.
2. **Goal-object.** This is the entity to which the goal applies or that will benefit from the goal's achievement. A goal-object will typically be one of the set from the first column of Table 2: individual, system, portfolio, and so on.
3. **Environment.** This is the context for this goal. It acts as a rationale for the goal. One source for this entry is found in the five different environmental factors of Osterwalder and Pigneur: social, legal, competitive, customer, and technological [Osterwalder 2004].
4. **Goal.** This is an element from Table 1, or any business goal (whether in the table or not) that can be articulated by the person being interviewed.
5. **Goal-measure.** This is a measurement to determine whether the goal has been achieved.

6. **Pedigree and value.** This tells us the degree of confidence in the goal, the goal's volatility, and the value of achieving the goal.

### **Pedigreed Attribute eLicitation Method (PALM)**

First, we want to empower architects to spot the likelihood of missing requirements by giving them a clear and full picture of the operative business goals. Second, we want to empower architects to be able to question difficult requirements that may not be necessary because they do not support any important business goal.

Toward these two ends, we have developed a method called the Pedigreed Atttribute eLicitation Method (PALM) and have tried it out in a real-world setting.

The steps of PALM, which can be carried out in a two-day exercise, are as follows. For each step a nominal duration is given.

1. **PALM overview presentation:** overview of PALM, the problem it solves, its steps, its expected outcomes. (30 minutes)
2. **Business drivers presentation:** discussion of business drivers by project management. What are the goals of the customer organization for this system? What are the goals of the development organization? (60 minutes)
3. **Architecture drivers presentation:** briefing by the architect on the driving (shaping) business and quality attribute requirements. (30 minutes)
4. **Business goals elicitation exercise:** Using the standard business goal categories of Table 1 to guide discussion, we capture the set of important business goals for this system. Business goals are elaborated and prioritized, and expressed as business goal scenarios. (2 hours)
5. **Identifying potential quality attributes from business goals:** For each important business goal scenario, participants describe a quality attribute that (if architected into the system) would help achieve it. (2.5 hours.)
6. **Assignment of pedigree to existing quality attribute drivers:** For each architectural driver named in Step 3, we identify which business goal(s) it is there to support. If it supports none, or if any supported business goal has a questionable pedigree such as low value or high volatility, that is recorded as a risk. Otherwise, it is recorded as a non-risk. (2.5 hours)
7. **Exercise conclusion:** review of results, next steps, and participant feedback. (30 minutes)

### **Validating the Method**

We held a workshop in Pittsburgh and one in Amsterdam in April 2009 to help us validate the approach laid out in this report. We invited a number of architecture experts to the workshops in each venue: people whose experience in developing architectures based on quality attribute requirements runs long and deep. At these workshops, we presented the elicitation approach and took comments, criticisms, and ideas for improvement. We also conducted a mock elicitation exercise at each workshop to gain preliminary experience with the practicalities of using PALM with live subjects. Both workshops validated for us the strong link between business goals and quality attribute requirements. The participants gave us strong encouragement as to the usefulness of establishing a business-goal-based pedigree for quality attribute requirements early

in the life cycle, and they told us how a method such as PALM could be used to support Request for Proposal (RFP) activities as well as activities to respond to an RFP.

### **Piloting the Method**

We piloted PALM in a day-and-a-half engagement with Boeing Air Traffic Management on August 30 and Sept 1, 2009. We conducted the pilot as an interview with the project manager and the project architect. The pilot produced value for Boeing, uncovering a number of business goals that had previously not been known, or at best had only been implicit in the minds of the participants. After the pilot, the architect presented the results of the pilot to his management team, and the project manager shared the results with the project team.

---

## Abstract

The primary purpose of the architecture for a software-reliant system is to satisfy the driving behavioral and quality attribute requirements. Quality attribute requirements tend to be poorly captured and poorly represented in requirements specifications, which focus on functionality. It is often up to the architect's own initiative to capture the actual quality attribute requirements for a system under development. Quality attributes come about because of the business goals behind the system being developed. Business goals drive the conception, creation, and evolution of software-reliant systems. This report examines business goals from the point of view of the software architect. It presents a wide survey of business goal categories from the business literature and uses that survey to produce a classification of business goals. It introduces the concept of goal-subject (the person or entity who owns the business goal) and goal-object (the person or entity that the goal is intended to benefit). Those concepts are essential to the structure of a business goal scenario—a systematic way to elicit and express business goals. Using the concept of a business goal scenario drives the Pedigreed Attribute eLicitatiOn Method (PALM), developed by the authors for eliciting architecturally significant business goals. The report illustrates how to use architecturally significant business goals to produce a set of derived quality attribute requirements that can then be vetted and elaborated with the appropriate goal-subject(s) and goal-object(s). This approach has been vetted in two workshops and the method piloted in an industrial setting.





---

# 1 Introduction

## 1.1 The Requirements/Architecture Mismatch

The study of the principles and practices needed to produce a high-quality architecture constitutes a rich and productive field of investigation, pursued vigorously by the Carnegie Mellon® Software Engineering Institute (SEI) and others. However, that field has almost completely overlooked an inconvenient truth:

*There is a fundamental mismatch between the information that requirements specifications contain and the information that architects need.*

This mismatch manifests in two ways:

1. **Most of what is in a requirements specification does not affect the architecture.**  
Architectures are mostly driven or “shaped” by quality attribute requirements. These determine and constrain the most important architectural decisions. And yet the vast bulk of most requirements specifications is focused on the required features and functionality of a system, which shape the architecture the least. Worse, most do a poor job of specifying quality attributes; many ignore them altogether.
2. **Much of what is useful to an architect is not in even the best requirement specification.**  
Many concerns that drive an architecture do not manifest as observables in the system being specified and so do not appear in requirements specifications. These often derive from business goals in the development organization itself, such as keeping people productively employed, amortizing investments in existing tools and technologies, satisfying human resource concerns, improving the organization’s market position relative to its competition, and others. This relation between business goals and the architecture has been identified by others as well as the authors of this report. See, for example works by Gross, Velasquez, and Sangwan [Gross 2000, Velasquez 2006, Sangwan 2007].

## 1.2 Business Goals Beget Quality Attributes

Every quality attribute—such as user-visible response time or platform flexibility or ironclad security or any of a dozen other needs—should originate from some higher purpose that can be described in terms of added value.

If we ask, for example, “*Why* do you want this system to have a really fast response time?” we might hear that this will differentiate the product from its competition and let the developing organization capture market share; or that this will make the soldier a more effective warfighter, which is the mission of the acquiring organization; or other reasons having to do with the satisfaction of some business goal.

This relationship between corporate goals and project goals seems self-evident, but is apparently not well understood in the business literature. Indeed, “there is a dearth of writing about how corporate strategy gets translated into implementation, particularly at the program or project

---

® Carnegie Mellon is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

level” [Morris 2005]. Instead, “much of traditional management writing tends only to cover the strategic management processes that formulate and implement strategy at the corporate level.” In writing about this relationship, Morris and Jamieson produce a picture (Figure 1) that conveys approximately the idea we describe.<sup>1</sup>

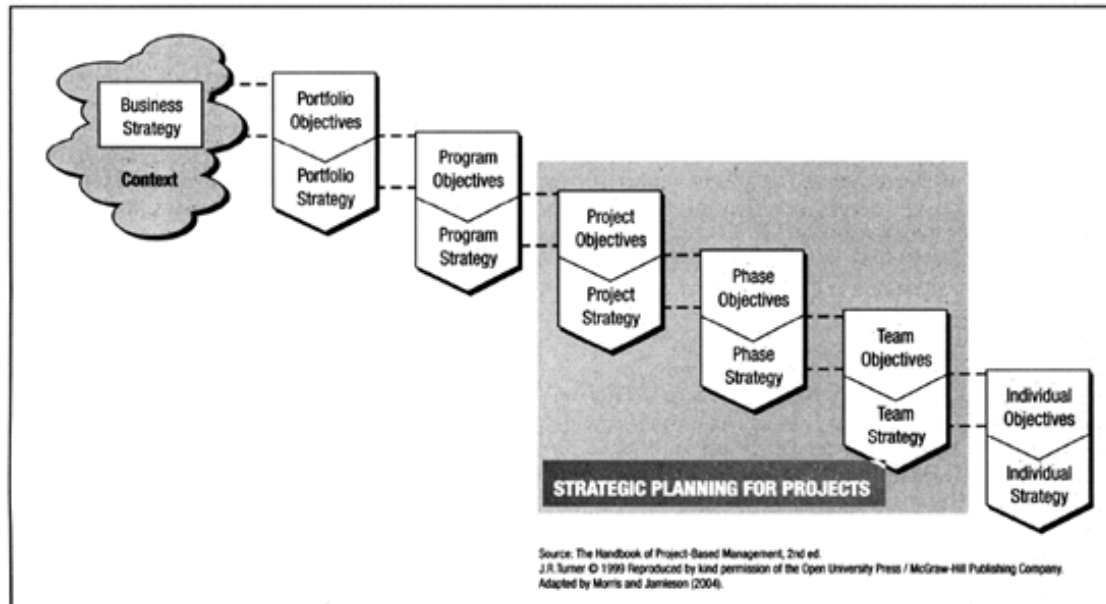


Figure 1: Corporate Goals Should Drive Project Goals [Morris 2005]

Whereas quality attributes should flow from business goals, not all business goals lead to quality attributes. For example, the goal to reduce costs may be satisfied by lowering the facility’s thermostats in the winter or reducing employees’ pensions.

Still other business goals may directly affect the architecture without precipitating a quality attribute requirement per se. For example, a software architect related to us that some years ago he delivered an early draft of the architecture to his manager. The manager remarked that a database was missing from the architecture. The architect, pleased that the manager had noticed, explained how he had devised a design approach that obviated the need for a bulky, expensive database. The manager, however, pressed for the design to include a database *because the organization had a database unit employing a number of highly paid technical staff that currently were unassigned and needed work*. No requirements specification would capture such a requirement, nor would any manager allow such a motivation to be captured. And yet that architecture, had it been delivered without a database, would have been just as deficient from the point of view of the manager as if it had failed to deliver an important functionality or quality attribute.

Figure 2 illustrates the major points above. In the figure, the arrows mean “leads to.” The solid arrows highlight the relationships of most interest to us.

<sup>1</sup> Their paper contains an excellent summary of the literature, such as it is, linking corporate and project goals.

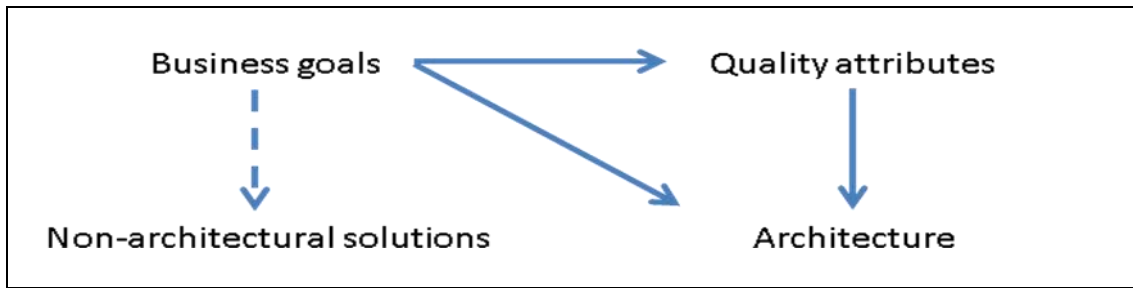


Figure 2: Some Business Goals May Lead to Quality Attribute Requirements (Which Lead to Architectures), or Lead Directly to Architectural Decisions, or Lead to Non-Architectural Solutions.

### 1.3 Terminology

Throughout this report we will primarily use the term *business goal* to refer to an objective or target to be achieved by a business [American Heritage 2010]. The most routine case is when a stakeholder for an organization wants that same organization to achieve something of value.

In the U.S. Department of Defense (DoD), two related terms arise and should be reconciled.

1. A *mission goal* (sometimes *mission driver*) is an expression of a goal concerning the achievement of some mission, usually military and operational in nature.
2. An *acquisition goal* (sometimes *acquisition driver*) is a goal of an acquisition organization to meet certain objectives, usually related to cost and schedule or contractual matters. acquisition organizations also have goals to acquire systems that help warfighters achieve their mission goals.

Mission goals are often expressed in terms of *key performance parameters* such as “interoperability.” These can be elaborated and refined into *key system attributes* that the system must exhibit in order to be acceptable.

For the purposes of this report, all of these terms are synonymous. For example, an acquisition goal can be seen as a business goal of an acquisition organization. A mission goal can be seen as the business goal of a warfighting organization. A DoD contracting organization will have to build systems that serve both DoD mission goals and its own business goals. The DoD has already adopted the business paradigm for its warfighting capability when, for example, the Army speaks of building an enterprise architecture to let a warfighter access networks from anywhere in the world [Bergey 2009].

### 1.4 Purpose

Our purpose is to facilitate better capture and expression of high-pedigree, architecturally significant requirements. “Architecturally significant requirements are those requirements that play an important role in determining the architecture of the system ...e.g., the system must record every modification to customer records for audit purposes. The system must respond within five seconds” [EPF 2010]. A major source of architecturally significant requirements is the set of business goals that led to the system’s being developed. Therefore, we want to be able to elicit business goals reliably and understand how those business goals influence quality attribute requirements and architectures.

The elicitation approaches outlined in this report can be used by requirements engineers who want to produce a set of requirements helpful to the software architect; by parties such as those running SEI Quality Attribute Workshops [Barbacci 2003]; or by the architect in cases where nobody else produced such requirements.

After reading this report, any of these parties should be able to

1. use a candidate set of business goals to help elicit the business goals that are driving the project at hand
2. produce a set of quality attribute requirements that could reasonably be expected to apply to the project at hand, given the operative business goals. This expected set can then be compared to the existing set; a mismatch gives the architect a reason to probe deeper into the requirements.

## **1.5 Organization of this report**

The outline of this report is as follows:

- Section 2, “Classifying Business Goals,” synthesizes our own categorization of business goals based on the categories identified in the Appendix. It also introduces the notions of goal-subject (the entity having the goal) and goal-object (the entity to which the goal applies).
- Section 3, “Expressing Business Goals,” introduces the business goal scenario, a mechanism for capturing and expressing business goals in a consistent and useful manner.
- Section 4, “From Business Goals to Quality Attributes,” shows how to use business goal scenarios in a multi-step technique for eliciting and capturing business goals that will have architectural impact and also for deriving the resulting quality attribute requirements. It describes how we have validated and piloted the approach in an industrial setting.
- Section 5 summarizes and discusses how our work may be incorporated into the body of SEI architecture-centric engineering practices.
- The Appendix summarizes an extensive literature search to present categories of business goals used by other authors.

---

## 2 Classifying Business Goals

This section summarizes the literature survey presented in the Appendix to produce a systematic way to classify business goals that we will use to guide their elicitation.

### 2.1 Eschewing a Taxonomy

First, we dispense with the notion of a business goal *taxonomy*. A taxonomy must exhibit mutual exclusivity; that is, a subject must belong to one taxon and one taxon only [Mäkinen 2007].

None of the classification schemes we present in the Appendix are taxonomies; they all fail the mutual exclusivity test. An extensive search of the business literature has revealed no existing taxonomy of organizational business goals.

Happily, we do not need a taxonomy. Our goal is to provide a classification that will help us ask the right questions about an organization's reasons for developing or acquiring a software-reliant system. Each category should prompt questions about the existence of organizational business goals that fall into that category. If the categories overlap, then this might cause us to ask redundant questions. This is not harmful and is probably helpful—redundancy being a well-known tactic for achieving reliability.

### 2.2 Synthesis of Business Goal Categories

Many of the works summarized in the Appendix offer their own sets of business goals. By performing an affinity exercise among all of the goals mentioned, we have created the following set of business goal categories that synthesize all of the previous results:

- Maintaining growth and continuity of the organization
- Meeting financial objectives
- Meeting personal objectives
- Meeting responsibility to employees
- Meeting responsibility to society
- Meeting responsibility to country
- Meeting responsibility to shareholders
- Managing market position
- Improving business processes
- Managing quality and reputation of products

Table 1 shows the business goals cited in the Appendix that contribute to each category. We can use these categories to facilitate business goal elicitation, to help stimulate stakeholders' thinking, and to help gauge the coverage and completeness of an elicited set.

Table 1: Synthesized Business Goal Categories

| Category   | Hofstede et al.:<br>“Hofstede goals” | Usunier et al.: Ethical (E)<br>or Self-Interest (SI)* | Fulmer: Business<br>Goals for CEOs                                    | Porter: Marketing<br>Strategies  | Kazman and Bass:<br>Business Goals<br>Collected from<br>ATAM Exercises | Osterwalder and<br>Pigneur: An Ontology<br>for Business Models | de Reuver, Bouwman,<br>and MacInnes: What<br>Drives Business Models |
|--|--------------------------------------|---|---|--|--|--|---|
| Maintaining<br>growth and<br>continuity of the<br>organization | Growth of the business               | SI*   | Maximize the company's rate<br>of growth<br><br>Increase sales growth |  |  |  |   |
|  | Continuity of the business           | SI  | Survival<br><br>Run a stable organization                             |  |  |  |   |
| Meeting<br>financial<br>objectives                             | This year's profits                  | SI*   | Maximize profits over the short<br>run                                |  |  | Manage financial<br>aspects (revenue<br>flows, etc.)           |   |
|  | Profits 10 years from now            | SI  | Maximize profit over the long<br>run                                  |  |  |  |   |
|  |                                      |   | SI  | Achieve business goals<br>through financial objectives<br><br>Maximize the company's net<br>assets and reserves<br><br>Keep tax payments to a<br>minimum |  |  |   |
| Meeting<br>personal<br>objectives                              | Personal wealth<br><br>Power         | SI*   |   |  |  |  |   |
|  | Honor, face, reputation              | SI  |   |  |  |  |   |
|  | Game and gambling spirit             |   |   |  |  |  |   |
|  | Family interests                     |   |   |  |  |  |   |

| Category                                   | Hofstede et al.:<br>"Hofstede goals"                      | Usunier et al.: Ethical (E)<br>or Self-Interest (SI)* | Fulmer: Business<br>Goals for CEOs   | Porter: Marketing<br>Strategies | Kazman and Bass:<br>Business Goals<br>Collected from<br>ATAM Exercises | Osterwalder and<br>Pigneur: An Ontology<br>for Business Models | de Reuver, Bouwman,<br>and MacInnes: What<br>Drives Business Models |
|--|---|---|--|---------------------------------|--|--|---|
|  | Creating something new                                    |   | Be the leading innovator in the industry   |                                 |  |  |   |
| <b>Meeting responsibility to employees</b> | Responsibility toward employees                           | E*  | Provide high rewards and benefits to employees<br>Create a pleasant and friendly workplace<br>Have satisfied employees |                                 |  |  |   |
| <b>Meeting responsibility to society</b>   | Respecting ethical norms<br>Responsibility toward society | E*  | Run an ethical organization<br>Be a socially responsible company<br>Be of service to the community                     |                                 |  | Social environment   | Operate effectively within social environment                       |
|  | Staying within the law                                    | E*  |  |                                 |  | Legal environment  | Regulatory drivers<br>Operate effectively within legal environment  |
| <b>Meeting responsibility to country</b>   | Patriotism, national pride                                | E   |  |                                 |  |  |   |



| Category                                     | Hofstede et al.:<br>"Hofstede goals" | Usunier et al.: Ethical (E)<br>or Self-Interest (SI)* | Fulmer: Business<br>Goals for CEOs  | Porter: Marketing<br>Strategies   | Kazman and Bass:<br>Business Goals<br>Collected from<br>ATAM Exercises | Osterwalder and<br>Pigneur: An Ontology<br>for Business Models | de Reuver, Bouwman,<br>and MacInnes: What<br>Drives Business Models        |
|--|--------------------------------------|---|---|---|--|--|--|
| Meeting<br>responsibility<br>to shareholders |                                      |   | Maximize dividends for the<br>shareholders                                      |   |  |  |  |
| Managing<br>market<br>position               |                                      | SI  | Be a market leader in your<br>respective market(s)<br>Maximize the market share | Focusing (on a specific<br>niche)   | Improve market position  | Competitive<br>forces<br>Customer<br>demand                    | Market drivers<br>Operate effectively<br>within competitive<br>environment |
| Improving<br>Business<br>Processes           |                                      | SI  |   | Replacement of labor by<br>automation<br>Diversification of operational<br>sequence<br>Elimination of intermediate<br>stages<br>Automatic tracking of<br>business events<br>Collection, communication,<br>and retrieval of operational<br>knowledge<br>Improvement of decision<br>making<br>Coordination across distance<br>Alignment between task and<br>process<br>Management on basis of<br>process measurements | Support improved<br>business processes                                 | Manage customer<br>relationship<br>Manage<br>infrastructure    |  |

| Category  | Hofstede et al.:<br>"Hofstede goals" | Usunier et al.: Ethical (E)<br>or Self-Interest (SI)* | Fulmer: Business<br>Goals for CEOs                         | Porter: Marketing<br>Strategies    | Kazman and Bass:<br>Business Goals<br>Collected from<br>ATAM Exercises   | Osterwalder and<br>Pigneur: An Ontology<br>for Business Models | de Reuver, Bouwman,<br>and MacInnes: What<br>Drives Business Models   |
|---|--------------------------------------|---|--|------------------------------------|--|--|---|
| Managing<br>quality and<br>reputation of<br>products <sup>2</sup> |                                      | SI  | Provide the best quality<br>products and services possible | Differentiation<br>Cost leadership | Improve capability/quality<br>of system<br>Improve confidence in<br>and perception of the<br>system<br>Reduce total cost of<br>ownership |  | Operate effectively<br>within customer<br>environment<br><br>Operate effectively<br>within technological<br>environment |

\* Entries marked with an asterisk were identified explicitly as either ethical or self-interest goals by Usunier and colleagues.  
 Entries not marked with an asterisk were assigned to categories by the authors.

---

<sup>2</sup> A more generous name for this category might be "Meeting responsibility to customers."

Literature included in the survey in the Appendix that is missing from Table 1 is listed below:

- Mitchell and Coles: Seven Key Elements of a Business Model (who, what, when, etc.) [Mitchell 2003]
- Mitchell, Agle, and Wood: Stakeholder Theory or “The Principle of Who or What Really Counts” [Mitchell 1997]
- McIntosh and Nelson: Changing business models can define an industry [McIntosh 2007]
- The Open Group Architecture Framework (TOGAF) [TOGAF 2009]

We will make use of these contributions shortly.

## 2.3 The Goal-Subject of Business Goals

Here we introduce the concept of a goal’s *subject*—that is, the person who has the goal. If the business goal is, for example, “maximize dividends for the shareholders,”<sup>3</sup> who is it that cares about that? It is probably not the programmers or the system’s end users (unless they happen to own stock).

Mitchell, Agle, and Wood’s Stakeholder Theory suggests candidate goal-subject(s) of a business goal and identifies people who might have business goals to contribute [Mitchell 1997]. In executing PALM, we will seek stakeholders with high “salience” from whom to elicit business goals, and record those stakeholders as the goal-subjects.

Many authors write about the importance of aligning strategies and goals throughout an organization. Morris and Jamieson’s “Moving from Corporate Strategy to Project Strategy” [Morris 2005] is an exemplar. Partington identifies three levels of strategy (corporate, business, and operational) that should be aligned with each other [Partington 2000]; see Figure 3.

Three different levels of strategy are commonly distinguished:

1. At the *corporate* level, strategy is concerned with what businesses the company as a whole should be in, and with justifying why—in terms of added value—those business units should be grouped together corporately.
2. At the *business* level, strategy involves determining what markets a business unit is competing in, how it should compete, where it wants to go and how it should get there. The answer to the last question will result in the creation of programmes of projects to enable business units to achieve their strategies.
3. *Operational* level strategies focus on the role of individual departments and functions (marketing, human resources, manufacturing, finance, etc.), and on individual programmes or projects, in delivering the business level strategy.

Figure 3: Partington's Three Levels of Strategy [Partington 2000]

<sup>3</sup> This idea was presented by Robert Fulmer through American Management Associates in 1978 and can be found in an article by J.M. Beggs and M.S. Lane [Beggs 1989].

These and other similar treatments (such as TOGAF’s human actors) speak to the person who has a goal—that is, the goal-subject—and alignment of goals across goal-subjects.

For the same reasons we don’t need a taxonomy of goals, goals with multiple goal-subjects are not detrimental to goal elicitation. But the realization that goals have subjects should lead us to ask for them when we elicit business goals—and not be surprised when more than one goal-subject per goal is revealed.

One way to classify goal-subjects is by the organization to which they belong. Multiple organizations are involved in the construction of modern systems. The customer, acquirer, and developer organizations are the norm, but each of these may interact with still other organizations. The developing organization, for example, may subcontract a portion of the development; it may be that a portion of the development is a modification of an open source system, in which case the developers of the open source portion of the system being developed become stakeholders. The system being acquired may need to interoperate with other existing systems or other systems being constructed, and stakeholders of those systems constitute potential goal-subjects.

In some cases, the goal-subject for a goal may be an organization, as opposed to specific individuals. This is often manifested through anonymously written documents produced by that organization.

## 2.4 The Goal-Object of Business Goals

Here we introduce the concept of a goal’s *object* (in the sense of a verb’s object in a sentence).

Instead of simply asking “What are your business goals?” we can ask: “What do you wish to be true for or about **X** as a result of developing or acquiring this system?” The placeholder **X** is the goal’s object, the entity to which the goal applies.

All goals have goal-objects—we want something to be true about something (or someone) that (or whom) we care about. For example, for goals we would characterize as furthering one’s self-interest, the goal-object can be “myself or my family.” For goals we would characterize as ethical, the goal-object can be “the social or natural environment.” For some goals the goal-object is clearly the development organization, but for some goals the goal-object can be more refined, such as the rank-and-file employees of the organization or the shareholders of the organization. For DoD acquirers, we often hear concern voiced for “the warfighter,” another kind of goal-object.

Some goals may have more than one goal-object. For example, consider Fulmer’s “Maximize profits over the short run.” Here, the goal-object can obviously be the developing organization. But it might also be “myself” if that organization has profit sharing. Capitalists in the Ayn Rand school would certainly argue that society at large is a valid goal-object for this goal.<sup>4</sup>

Goals with multiple goal-objects are not harmful to the process of eliciting business goals.

---

<sup>4</sup> See, for example, M. Friedman, “The Social Responsibility of Business Is to Increase Its Profits,” *New York Times*, September 13, 1970: 122-126.

Table 2 below lists all of the business goals identified in the Appendix clustered by the goal-object for which the goals seem primarily aimed. It is, in other words, a representative cross-section of goal-objects based on a thorough literature search.

Goal-objects in Table 2 start small, where the goal-object is a single individual, and incrementally grow to society at large.<sup>5</sup>

*Table 2: Business Goals and Their Goal-Objects*

| Goal-object                 | Corresponding business goals   | Remarks   |
|-----------------------------|--|---|
| Individual                  | Personal wealth, power, honor/face/reputation, game and gambling spirit, maintain or improve reputation (personal), family interests   | The individual who has these goals has them for him/herself or his/her family.  |
| System                      | Managed flexibility, distributed development, portability, open systems/standards, testability, product lines, integrability, interoperability, ease of installation and ease of repair, flexibility/configurability, performance, reliability/availability, ease of use, security, safety, scalability/extendability, functionality, system constraints, internationalization, distributed development. reduced time to market  | These can be goals for a system being developed or acquired. The list applies to systems in general, but the quantification of any one item likely applies to a single system being developed or acquired.  |
| Portfolio <sup>6</sup>      | Reduced cost of development, cost leadership, differentiation, focusing, reduced cost of retirement/moving to a new system, retiring systems, smooth transition to follow-on systems and replaced legacy systems, replacement of labor by automation, diversification of operational sequence, elimination of intermediate stages, automatic tracking of business events, collection/communication/retrieval of operational knowledge, improvement of decision making, coordination across distance, alignment between task and process, management on basis of process measurements, operate effectively within competitive environment, operate effectively within technological environment, operate effectively within customer environment.<br>Arto and Dietrich goals<br>Creating something new, provide the best quality products and services possible, be the leading innovator in the industry | These goals seem to live on the cusp between an individual system and the entire organization. They apply either to a single system, or to an organization's entire portfolio that the organization is building or acquiring to achieve organization-wide goals.<br><br>The Arto and Dietrich goals could apply to an individual, an organization's employees, or a whole organization. |
| Organization's employees    | Provide high rewards and benefits to employees, create a pleasant and friendly workplace, have satisfied employees, responsibility toward employees, maintain jobs of workforce on legacy systems  | Before we get to the organization as a whole, there are some goals aimed at specific subsets of the organization.   |
| Organization's shareholders | Maximize dividends for the shareholders  |   |
| Organization                | Growth of the business, continuity of the business, this year's profits; profits ten years from now; maximize profits over the short run; maximize profits over the long run, survival (of the organization), maximize the company's net assets and reserves, be a market leader in your respective market(s), maximize the market share, expand or retain market share, enter new markets, maximize the company's rate of growth, keep tax payments to a minimum, increase sales growth, maintain or improve reputation (of the organization), achieve business goals through financial objectives, run a stable organization   | These are goals for the organization as a whole. The organization can be a development or acquisition organization, although most were undoubtedly created with the former in mind.   |
| Nation                      | Patriotism, national pride   | Before we get to society at large, this goal-object is specifically limited to the goal owner's own country.  |

<sup>5</sup> There were no business goals uncovered in our search whose goal-subject was explicitly the larger, non-human, natural environment.

<sup>6</sup> A *portfolio* is "a group of projects that are conducted under the sponsorship or management of a particular organization" [Archer 1999] or "a set of projects that are managed in a coordinated way to deliver benefits that would not be possible if the projects were managed independently" [Platje 1994]. A software product line is an example of a portfolio in the latter sense [Clements and Northrop 2002].

|         |   |  |
|---------|---|--|
| Society | Run an ethical organization; respecting ethical norms, responsibility towards society, be a socially responsible company, be of service to the community, operate effectively within social environment, staying within the law, operate effectively within legal environment | Some interpret "society" as "my society," which puts this category closer to the Nation goal-object, but we are taking a broader view. |
|---------|---|--|

## 2.5 Summary of This Section

At this point we have a useful classification of business goals that we can set forth to stimulate discussion ("Do you care about meeting financial objectives? What about meeting responsibilities to employees?"). We also have the notions of a goal's goal-subject and goal-object,<sup>7</sup> which will likewise stimulate discussion ("Who are your stakeholders? Who or what is the beneficiary of this goal?"). Together these give us the skeleton of a syntactic structure in which to express business goals and the beginnings of a stakeholder-based process to elicit them.

---

<sup>7</sup> Although she doesn't use our terms, Anton nicely summarizes what we mean by goal-subject and goal-object: "The stakeholders for each goal are determined by asking who or what claims a stake in this goal and who or what stands to gain or lose by the completion or prevention of this goal" [Anton 1998].



---

## 3 Expressing Business Goals

Capturing business goals and then expressing them in a standard form will let them be discussed, analyzed, argued over, rejected, improved, reviewed—in short, all of the same activities that result from capturing any kind of requirement. This section discusses how to capture and express business goals in a structured, consistent fashion. We begin by looking at two areas of related work.

### 3.1 Related Work: TOGAF Business Scenarios

In the Appendix we discuss how business goals are expressed as scenarios under the guidance of TOGAF. Besides giving rich guidance on how to gather, analyze, and review scenarios, this framework also provides a very complete template for documenting a business scenario (Figure 4). While TOGAF contains a wealth of useful information, we believe architects can make use of a lighter weight means to capture a business goal.



|   |
|---|
| PREFACE   |
| EXECUTIVE SUMMARY                                       |
| DOCUMENT ROADMAP  |
| BUSINESS SCENARIO                                       |
| BUSINESS SCENARIO OVERVIEW                              |
| BACKGROUND OF SCENARIO                                  |
| PURPOSE OF SCENARIO                                     |
| DEFINITIONS/DESCRIPTIONS OF TERMS USED                  |
| VIEWS OF ENVIRONMENTS AND PROCESSES                     |
| BUSINESS ENVIRONMENT                                    |
| Constituencies  |
| PROCESS DESCRIPTIONS                                    |
| Process “a”   |
| etc. ...  |
| TECHNICAL ENVIRONMENT                                   |
| Technical environment “a”                               |
| etc. ...  |
| ACTORS AND THEIR ROLES AND RESPONSIBILITIES             |
| COMPUTER ACTORS AND ROLES                               |
| RELATIONSHIP OF COMPONENTS AND PROCESSES                |
| HUMAN ACTORS AND ROLES                                  |
| RELATIONSHIP OF HUMANS AND PROCESSES                    |
| INFORMATION FLOW ANALYSIS                               |
| PRINCIPLES AND CONSTRAINTS                              |
| IT Principles   |
| Constraints   |
| REQUIREMENTS  |
| BUSINESS SCENARIO ANALYSIS                              |
| PROBLEM SUMMARY   |
| Issues  |
| Objectives  |
| SUMMARY   |
| APPENDIXES  |
| APPENDIX A: BUSINESS SCENARIOS - ADDITIONAL INFORMATION |
| APPENDIX B-n: BUSINESS SCENARIO WORKSHOP NOTES          |

Figure 4: TOGAF Template for Documenting a Business Scenario

### 3.2 Related Work: Goal-Oriented Requirements Engineering

Goal-oriented requirements engineering emerged in the late 1990s as a way to derive requirements from overarching goals that stakeholders have for a system. It was a recognition that requirements seldom spring fully formed out of the minds of stakeholders, but are the result of refinement and elaboration of goals that stakeholders have to begin with. Under this view, a particular set of requirements is a way (possibly not the only way) to achieve the goals of the stakeholders.

For example, a requirement may call for a 0.7-second response time for a user interaction. But the goal behind this requirement is to keep users from becoming frustrated with the interactive system. Knowing only the requirement, we might think that a 0.78-second response time would be unacceptable; knowing the goal lets us understand that 0.78 seconds may well be just fine.

Capturing the goals behind requirements helps to relate requirements to the organizational and business context, clarify requirements, deal with conflicts, drive design, capture a requirements rationale, and even help facilitate requirements reuse [Yu 1998]. Capturing goals also helps in achieving requirements completion and avoiding irrelevant requirements [van Lamsweerde 2001].

Many classification schemes exist for goals, but these are usually based on the semantics of the goal itself. A typical classification scheme uses (or looks for) keywords such as “achieve,” “avoid,” “maintain,” “improve,” “increase,” “reduce,” “make,” and so forth, or words that indicate temporal patterns that will hold (or not hold) in the future [van Lamsweerde 2001]. A *maintenance* goal is satisfied as long as its target condition remains true. An *achievement* goal is satisfied when its target condition is attained [Antón 1997].

Dependencies exist among goals. A goal might be a sub-goal of another, or be completed before another, or provide information to another, or contractually require another, and so forth. Goals can also have harmful dependencies or “obstacles,” such as when one goal blocks the achievement of another [Antón 1997].

Figure 5 shows a template for capturing a goal using a scenario.

|                        |                  |
|------------------------|------------------|
| <b>Goal:</b>           | <i>Name</i>      |
| <b>Type:</b>           | <i>Name</i>      |
| <b>Description:</b>    | <i>Text</i>      |
| <b>Action:</b>         | <i>Name</i>      |
| <b>Agent:</b>          | <i>Name(s)</i>   |
| <b>Stakeholders:</b>   | <i>Name(s)</i>   |
| <b>Constraints:</b>    | <i>Items</i>     |
| <b>Obstacles:</b>      | <i>Items</i>     |
| <b>Preconditions:</b>  | <i>Condition</i> |
| <b>Postconditions:</b> | <i>Condition</i> |
| <b>Subgoals:</b>       | <i>Name(s)</i>   |

Figure 5: Schema for Goals [Antón 1997]

### 3.3 Business Goal Scenarios

Like creators of TOGAF and some segments of the goal-oriented requirements engineering community, we choose to express business goals using scenarios. The purpose of a business goal scenario is to ensure that all business goals are expressed clearly, in a consistent fashion, and contain sufficient information to enable their shared understanding by relevant stakeholders. Business goal scenarios will also lend themselves to processing through the remaining steps of our technique.

We have chosen a scenario template based on the previously cited work, plus Mitchell and Coles’ “who-what-why” model of business goals, plus our own experience in capturing quality attribute

requirements with scenarios [Mitchell 2003, Bass 2003]. Just as a quality attribute scenario adds precision and meaning to an otherwise vague need for, say, “modifiability,” a business goal scenario will add precision and meaning to a desire to “meet financial objectives” or “increase market share.”

Our business goal scenario template has six parts. They all relate to the system under development, the identity of which is implicit. The parts are the following:

1. **Goal-subject.** This is the stakeholder who owns the goal, who wishes that it be met. The stakeholder may be an individual, an individual in an identified organization if more than one organization is in play, or (in the case of a goal that has no one owner and has been assimilated into an organization) the organization itself.
2. **Goal-object.** This is the entity to which the goal applies. A goal-object will typically be one of the set from the first column of Table 2: individual, system, portfolio, and so on.
3. **Environment.** This is the context for this goal. For example, there are social, legal, competitive, customer, and technological environments [Osterwalder 2004]. Sometimes the political environment is key, as a kind of social factor. If upcoming technology is a major factor, Bodde’s 2x2 matrix can be used to express its potential for upsetting the current business model [Bodde 2007].
4. **Goal.** This is an element from Table 1, or any business goal (whether in the table or not) that the person being interviewed can articulate. One way to express the goal is to use Anton’s precondition/postcondition form.
5. **Goal-measure.** This is a measurement for determining whether the goal has been achieved. The goal-measure should usually include a time component, stating the time by which the goal should be achieved.
6. **Pedigree and value.** The pedigree of the goal tells us who stated the goal, the degree of confidence the person who stated the goal has in it, and the goal’s volatility and value. The value of a goal can be expressed by how much its owner is willing to spend to achieve it or its relative importance compared to other goals. Relative importance may be given by a ranking from 1 (most important) to  $n$  (least important), or by assigning each goal a value on a fixed scale such as 1 to 10 or high-medium-low. We combine value and pedigree into one part, since in the method we present in Section 4.1 we elicit both at the same time. It certainly is possible to treat them separately. The important concern is that both are captured.

Elements 1–5 can be combined into a sentence that reads

*For the system being developed, <goal-subject> desires that <goal-object> benefit from <goal> in the context of <environment> and will be satisfied if <goal-measure>.*

The sentence can be augmented by the goal’s pedigree and value (element 6). Some sample business goal scenarios include

- For MySys, the project manager has the goal that his family’s stock in the company will rise by 5 percent (as a result of the success of MySys).
- For MySys, the developing organization’s CEO has the goal that MySys will make it 50 percent less likely that his nation will be attacked.

- For MySys, the portfolio manager has the goal that MySys will make the portfolio 30 percent more profitable.

In many contexts, the goals of different stakeholders may conflict. By identifying the stakeholder who owns the goal, the sources of conflicting goals can be identified.

These and other business goals, once elicited and captured, should lead to asking how the architect can design the system under development to help achieve those goals.

### **3.4 A General Scenario for Business Goals**

A general scenario is a template for constructing specific or “concrete” scenarios [Bass 2003]. It uses the generic structure of a scenario to supply a list of possible values for each non-boilerplate part of a scenario.

We can represent a general scenario for business goal scenarios using a table, where the possible values for each part of the scenario are shown in the columns of the table. Table 3 does this for business goals. Table 3 is not exhaustive, but it can aid in producing exemplary scenarios.

Table 3: General Scenario Generation Table for Business Goals

| 1. Goal-subject  | ...has the goal that... | 2. Goal-object  | ...achieves... | 4.Goal   | ...in the context of... | 3. Environment   | ...and will be satisfied if... | 5. Goal-measure (examples, based on goal categories)   | 7. Pedigree: Source, importance, volatility, and value                |
|--|-------------------------|---|----------------|--|-------------------------|--|--------------------------------|--|---|
| Any stakeholder or stakeholder group identified as having <i>legitimacy</i> and high <i>salience</i> |                         | Individual<br>System<br>Portfolio<br>Organization's employees<br>Organization's shareholders<br>Organization<br>Nation<br>Society |                | Maintaining growth and continuity of the organization<br>Meeting financial objectives<br>Meeting personal objectives<br>Meeting responsibility to employees<br>Meeting responsibility to society<br>Meeting responsibility to country<br>Meeting responsibility to shareholders<br>Managing market position<br>Improving Business Processes<br>Managing quality and reputation of products<br>Managing change in environmental factors |                         | Social (includes political)<br>Legal<br>Competitive<br>Customer<br>Technological |                                | Time that business remains viable<br>Financial performance vs. objectives<br>Promotion or raise achieved in period<br>Employee satisfaction; turnover rate<br>Amount given to charity<br>Contribution to trade deficit/surplus<br>Stock price, dividends<br>Market share<br>Time to carry out a business process<br>Quality measures of products<br>Technology-related problems<br>Time window for achievement | Value:<br>1- <i>n</i><br>1-10<br>H-M-L<br>Resources willing to expend |

### 3.5 A Document Summarizing Business Goals

A document summarizing the business goals would be helpful. As an example, Partington suggests capturing business goals in a *business requirements definition* document that is separate from a project's requirements definition [Partington 2000]. Figure 6 shows the contents of Partington's business requirements definition.

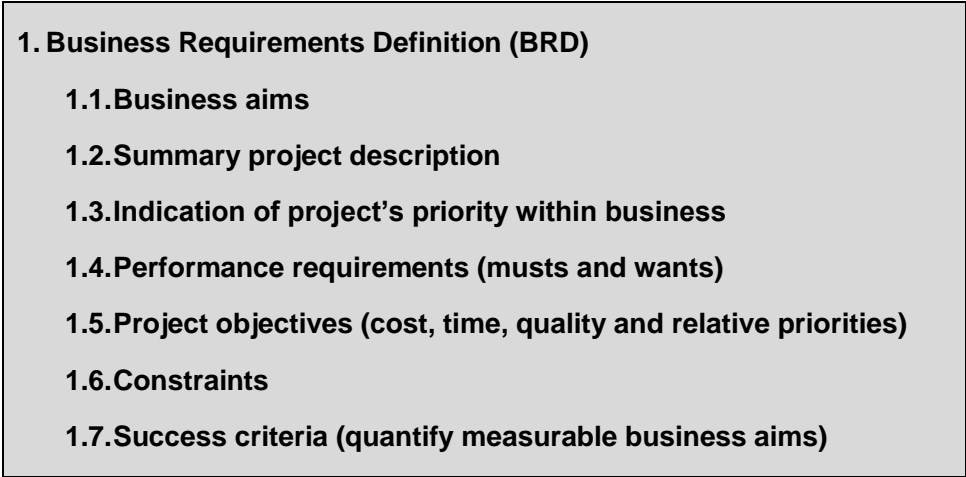
- 
- 1. Business Requirements Definition (BRD)**
    - 1.1. Business aims**
    - 1.2. Summary project description**
    - 1.3. Indication of project's priority within business**
    - 1.4. Performance requirements (musts and wants)**
    - 1.5. Project objectives (cost, time, quality and relative priorities)**
    - 1.6. Constraints**
    - 1.7. Success criteria (quantify measurable business aims)**

Figure 6: Contents of a Business Requirements Definition [Partington 2000]

Business goal scenarios could constitute the performance requirements and project objectives in such a document.

However, a lighter weight approach to recording this information could be appealing to many practitioners. A simple spreadsheet could serve well in many cases.



---

## 4 From Business Goals to Quality Attributes

Our goal is twofold. First, we want to empower architects to recognize the likelihood of missing requirements by giving them a clear and full picture of the operative business goals. Second, we want to empower architects to question difficult requirements that may not be necessary because they do not support any important business goal.

### 4.1 PALM

Towards these two ends, we have developed a prototype method called the Pedigreed Attribute eLicitation Method (PALM) and have piloted it in a real-world setting. The output of PALM is a prioritized list of business goals and the associated quality attribute requirements that derive from the stated business goals.

The steps of PALM, which can be carried out in a two-day exercise, are listed below. For each step a nominal duration is given.

1. PALM overview presentation: Overview of PALM, the problem it solves, its steps, its expected outcomes. (30 minutes)
2. Business drivers presentation: Briefing of business drivers by project management. What are the overarching business goals of the customer organization and development organization for this system? (These are likely to be broader and less precise than the goals elicited and refined in subsequent steps.) (60 minutes)
3. Architecture drivers presentation: Briefing by the architect on the driving (shaping) business and quality attribute requirements. (30 minutes)
4. Business goals elicitation exercise: Using the standard business goal categories of Table 1 to guide discussion, we capture the important business goals for this system. Business goals are elaborated and expressed as business goal scenarios. A system need not have a goal or goals from every row of Table 1, but Table 1 can act as a checklist where the vacant rows are explicitly (rather than implicitly) excluded. We also capture the effect of a change in any of the environmental factors on the business goal. Participants then prioritize the resulting set to identify the most important goals. Each goal derived should have as the goal-object something tied to the system under development (e.g. individuals, system, or portfolio). That is, goals with other goal-objects need to be translated into goals directly tied to the system under development. (2.0 hours)
5. Identifying potential quality attributes from business goals: For each important business goal scenario, participants describe a quality attribute that (if architected into the system) would help achieve it. If the quality attribute is already a requirement, this is recorded as a non-risk. If not, it is recorded as a risk. For each business goal in our extracted set, we express the quality attribute requirements that would allow the business goal to be satisfied, using the general scenario tables of Bass to suggest specific quality attributes [Bass 2003]. These tables embody possible quality attribute requirements that are, by definition, at either the system or the portfolio level. This translation process will be straightforward in many cases, since goals for the system or the portfolio are often expressed in quality attribute form



[Kazman 2005]. Architecturally significant requirements can be tentatively identified in this step. (2.5 hours)

6. Examination of existing quality attribute drivers: For each architecture driver named in Step 3, we identify which business goal(s) it is there to support. If it supports none, or if any of the business goals it supports is low priority or has a pedigree that indicates the goal is of low value or high volatility or questionable source, that's recorded as a risk. Otherwise, it's recorded as a non-risk. In that case, we also strengthen the quality attribute requirement by asking for the source of the quantitative part: For example, why is there a 40-ms performance requirement and not a 60-ms performance requirement? (2.5 hours)
7. Exercise conclusion: Review of results, next steps, and participant feedback. (30 minutes)

As with all stakeholder-elicitation methods, PALM relies on having the key stakeholders involved. "Key" stakeholders are ones who (according to the criteria of Stakeholder Theory) have high *salience*. Their involvement can vary either in location or in time. If all of the stakeholders are co-located at the same time, the PALM is conducted in a workshop fashion. If the stakeholders are separated in time, then PALM is conducted in an interview fashion. In our pilot, we conducted PALM as an interview.

Not all business goals can be achieved through quality attributes in a delivered system. However, architects are likely to be able to support business goals whose goal-object is "system" or "portfolio." The farther away the goal-object is from "system," the more likely the associated goal will be achieved through means outside an architect's purview, except in isolated circumstances. Conversely, it seems likely that business goals with the goal-object of either "system" or "portfolio" are ones that the architect can most affect; these are the types of goals that are directly transferable into architectural design decisions. In Step 5 we will pay special attention to business goals with the goal-object of "system" or "portfolio." We can scan the business goals looking for words like "system," "portfolio," "product," "product family," or proper names of the organization's products or portfolios. We will also look for business goals that can easily be rewritten so that the goal-object becomes "system" or "portfolio." For instance, a business goal that states an ambition for the organization to possess a market-leading portfolio has "organization" as the goal-object, but it is actually expressing an ambition for its portfolio and can be rewritten accordingly.

## 4.2 Validating the Method

We held a workshop in Pittsburgh and one in Amsterdam in April 2009 to help us validate the approach described in this report. We invited a number of architecture experts to the workshops at each venue, people with extensive experience in designing architectures based on quality attribute requirements. At these workshops, we presented the elicitation approach and took comments, criticisms, and ideas for improvement. We also conducted a mock elicitation exercise at each workshop to gain preliminary experience with the practicalities of using it with live subjects.

The Amsterdam workshop was attended by contractors and Dutch government personnel who were on the development and ownership sides, respectively, of a system called DigID. DigID is a system developed for the Dutch government. It provides authentication services for citizens who wish to use Dutch government web services. That is, a citizen will log into the website of a Dutch

government organization to perform some activity (for example, pay taxes). The website will use DigID to authenticate the citizen. We used a matrix to elicit and capture the business goals and associated quality attributes for DigID.

A sample outcome is the following. Having DigID highly available supports several business goals:

- Maintaining the continuity of the organization. DigID is the only reason the organization that owns it (government-based organization) exists. If the other branches of the government do not use DigID, the government-based organization (GBO) will cease to exist. The growth and continuity of the customers that depend on DigID are critically important to the GBO.
- Meeting financial objectives. There are internal (to the GBO) availability requirements. If these requirements are not met, funding from the government is in question.
- Maintaining employee satisfaction. Employees will get fewer calls (and be happier) if the system is highly available.
- Improving business processes. It is a goal of the tax office to improve its business processes, and the availability of DigID is an essential part of this improvement.
- Managing quality and reputation of products. The GBO wants DigID to be seen as a highly available service to maintain an excellent reputation among the citizenry.

This exercise validated for us the strong link between business goals and quality attribute requirements. The participants at both workshops gave us strong encouragement as to the usefulness of establishing a business goal-based pedigree for quality attribute requirements early in the life cycle, and they told us how a method such as PALM could be used to support Request for Proposal (RFP) activities as well as activities to respond to an RFP.

### 4.3 Piloting the Method

We applied PALM to a system being developed by Boeing's Air Traffic Management unit. We will call this system The System Under Consideration (TSUC). TSUC will provide certain on-line services to the airline companies to help improve the efficiency of their fleets. Thus, there were two classes of stakeholders for TSUC: Boeing and the airline companies. The stakeholders present when we used PALM were the chief architect and the project manager for TSUC.

**Step 2.** During the business drivers discussion several issues surfaced but we recorded nothing officially. One important element of this discussion was the identification of TSUC as an element of a newly planned product line.

**Step 3.** The architectural drivers identified during Step 3 included TSUC, as an element of a product line, and cost and schedule for delivery of TSUC. Security of information, usability of TSUC by airline personnel, real-time performance, and reliability were also identified as architectural.

**Step 4.** During Step 4, the canonical categories of business goals acted as triggers for detailed discussion. The discussion of goal category 1 ("Maintaining growth and continuity of the organization") overlapped with the discussion of goal category 2 ("Meeting financial objectives").

Goal category 4 (“Meeting objectives toward employees”) triggered a discussion of how TSUC would affect employees in the business unit and retention of software engineering personnel. This discussion also covered the impact of TSUC on the workload of airline company employees.

Goal category 5 (“Meeting obligations to society”) triggered a discussion of the regulatory environment in which airlines operate and the impact of this environment on TSUC. Furthermore, discussion of this goal led to a discussion of the future changes that might affect air traffic and how that might impact TSUC.

Goal category 6 (“Meeting responsibility to country”) triggered a discussion of whether TSUC could be used by the U.S. Department of Defense.

Goal category 8 (“Managing market position”) triggered a discussion of time to market and how that might be affected by architectural decisions. It also triggered a discussion of the potential export of TSUC.

Goal category 9 (“Improving business processes”) precipitated a discussion of governance for TSUC and how this might be impacted by the existence of the product line.

Goal category 10 (“Managing quality and reputation of products”) brought about a discussion about common look, feel, and usage of the products that will be in the product line.

The ten canonical business goals precipitated discussions that were wide ranging. All participants agreed that important issues were raised that were unlikely to have been considered in the goals’ absence. Even though the goal categories are quite abstract and unfocused, they were successful in triggering discussions that were relevant to TSUC. The result of each of these discussions was the capture of a specific business goal relevant to TSUC.

**Step 5.** Adding quality attributes to the discussion generated specific scenarios that could be useful to the architect designing a system. For example, one scenario dealt with changes in the regulatory environment affecting TSUC and the airline industry and how these changes should affect the partitioning of functionality in TSUC.

**Step 6.** Here, the architectural drivers presented in Step 3 were mapped to the high-priority business goals, and this mapping determined that all of TSUC’s architectural drivers were motivated by identifiable business goals.

It must be said that this was a lightweight pilot—we would have liked more stakeholders to participate, and we did not spend time prioritizing the business goals or using goal priorities in Step 5 or Step 6. Nevertheless, we feel we learned what it is like to apply the method in practice, and after the exercise, the architect and the project manager felt that the results were valuable and planned to present them to the Boeing management team and the project team, respectively.

---

## 5 Conclusions

We believe that quality attribute requirements drive architectures, and that business goals drive quality attribute requirements. To date, quality attributes seem to have received the bulk of the attention in this “influence” chain. Our work has attempted to do for business goals what other work in software architecture has done for quality attributes: treat them in a systematic, repeatable fashion that is borne from years of research and experience.

We have created a “standard” classification scheme for business goals and created a structured way to articulate them using the six-part business goal scenario. As a by-product of the scenario format, we have introduced the concepts of goal-subject, goal-object, and pedigree. We have identified the major forces that lead to business goals changing over time; these forces can become part of the elicitation.

We have created a facilitated method, PALM, that elicits business goals and establishes the link between those goals and the quality attribute requirements for a system under development. Where such a link cannot be established, this represents a risk to the success of the development. PALM helps an architect discover missing quality attribute requirements early and empowers the architect to question the necessity of overly stringent requirements by appealing to stakeholder-expressed business goals. Along the way, it helps to increase stakeholder communication and buy-in, and to put stakeholders on the same page with respect to the operative business goals.

PALM may go on to become a stand-alone method in the SEI arsenal of architecture-centric practices, or its important parts may become absorbed into the Quality Attribute Workshop or the Architecture Tradeoff Analysis Method, which both currently inquire about operative business goals in a less structured and systematic way.



---

## Appendix – Survey of Literature on Business Goals

This section presents a survey of the literature on business goals. Along the way we pick up some closely related work in marketing strategies and business models.

Business goals are the system's *raison d'être*. No organization builds a system (or commissions a contractor to build a system) on a whim; rather, it wants to further its mission and ambitions. Common business goals include making a profit, of course, but most organizations have many more concerns than simply profit.

In fact, sometimes profit is the furthest thing from an organization's motives. Acquisition organizations such as the U.S. Department of Defense have acquisition drivers, primary of which is to acquire a system that can meet their mission goals. Some organizations have business goals that deal with meeting an organization's corporate social responsibilities. These are "actions that appear to further some social good, beyond the interest of the firm and that which is required by law" [Usunier 2008, McWilliams 2001]. Corporate social responsibilities can include economic, legal, ethical, and philanthropic responsibilities [Carroll 1979, 1991]. Economic responsibilities are concerned with financial performance and the provision of goods and services; legal responsibilities are concerned with compliance with societal laws and regulations; ethical responsibilities relate to compliance with moral codes of conduct; and philanthropic (or discretionary) responsibilities relate to voluntary involvement and support of wider societal entities.

### A.1 Cross-National Business Goals

Hofstede and colleagues produced a set of 15 dominant business goals based on management literature as well as the authors' teaching and professional experience [Hofstede 2002]. Their list of goals is the basis for many other authors' investigations; the "Hofstede goals" are widely referenced.

Using these goals as the basis of a questionnaire, Hofstede and colleagues conducted a study to determine which goals were most important in 15 countries around the world. They surveyed junior managers and professionals taking spare-time MBA classes, collecting responses from 1,814 respondents composing 21 groups at 16 universities in 15 countries. Importance was rated separately for each goal on a five-point scale from "of utmost importance" to "of very little importance." They asked the respondents to give their own ratings but also to rate the importance of each goal from the perspective of "the typical successful business person" in their countries.

| <b>TABLE 2</b><br><b>MEAN RATED IMPORTANCE OF 15 BUSINESS GOALS ACROSS 21 COUNTRY/</b><br><b>UNIVERSITY GROUPS</b> |            |       |          |       |
|--|------------|-------|----------|-------|
| (standardized data; rank 1 = most important)   |            |       |          |       |
|  | For Tycoon |       | For Self |       |
|  | Rank       | Score | Rank     | Score |
| growth of the business   | 1          | 1.26  | 1        | 1.00  |
| continuity of the business   | 2          | 1.05  | 2        | .86   |
| this year's profits  | 3          | 1.01  | 9        | .26   |
| personal wealth  | 4          | .83   | 10       | .08   |
| power  | 5          | .68   | 12       | -.62  |
| honor, face, reputation  | 6          | .47   | 7        | .48   |
| creating something new   | 7          | .21   | 6        | .49   |
| profits 10 years from now  | 8          | .15   | 5        | .56   |
| staying within the law   | 9          | -.12  | 4        | .59   |
| responsibility towards employees   | 10         | -.30  | 3        | .64   |
| respecting ethical norms   | 11         | -.52  | 8        | .30   |
| responsibility towards society   | 12         | -.82  | 11       | -.06  |
| game and gambling spirit   | 13         | -1.09 | 14       | -1.57 |
| patriotism, national pride   | 14         | -1.26 | 13       | -1.28 |
| family interests   | 15         | -1.56 | 15       | -1.73 |

Figure 7: Fifteen Important Business Goals [Hofstede 2002]

Figure 7 shows the primary results statistically combined across all groups and countries. Although the point of the paper was to show cross-national differences in the importance of these goals, the list of goals is all we need for our purposes.

## A.2 Ethical versus Self-Interest Goals

Usunier, Furrer, and Perrinjaquet tried to determine whether business executives in different countries viewed goals rooted in self-interest as compatible with, neutral, or incompatible with goals based on “other” interest, such as following ethical mores to achieving humanitarian aims. They concluded that “While in some countries ethics and self-interest are perceived by managers as conflicting goals, in many countries self-interested and ethical goals are perceived as independent... [Also,] differences in managerial perceptions of goal importance and compatibility can be explained by institutional and cultural differences rather than by either the level of economic development of individual-level variables such as gender and work experience” [Usunier 2008].

Usunier, Furrer, and Perrinjaquet took their list of goal categories from the Hofstede study [Hofstede 2002] but divided them into self-interest goals and ethics-based goals shown in Figure 8. They surveyed 1,742 respondents from executive MBA classes in 15 countries. Each respondent was asked to score the importance of each of these goals for the typical successful businessperson in his or her country. Importance was rated for each goal on a five-point scale.

| Items                                    |
|--|
| <b>Ethics</b>                            |
| Respecting ethical norms (TETHI)         |
| Responsibility towards employees (TEMPY) |
| Responsibility towards society (TSOCI)   |
| Staying within the law (TLAWS)           |
| <b>Self-Interest</b>                     |
| Growth of the business (TGROW)           |
| Personal wealth (TWELT)                  |
| Power (TPOWR)                            |
| This year's profits (TPROF)              |

Figure 8: List of Business Goals Discriminated by Self-Interest versus "Other"-Interest [Usunier 2008]

### A.3 Business Goals for CEOs

In 1978, Robert Fulmer created a set of business goals for an American Management Institute study, later described by Beggs [Beggs 1989]. Like the “Hofstede goals,” the “Fulmer goals” also form a commonly cited set. Other researchers have used them to study chief executive officers [Lane 1987] and business students [Harpell 1986, Beggs 1989]. Figure 9 shows the goals as used in the Beggs study of business students and their perception of CEO goals.



| Goals   | Student<br>mean<br>rating | s.d.  | Perceptions<br>of CEO<br>mean rating | s.d.  | Student<br>rank | Perception<br>of CEO<br>rank | Mean rating<br>difference<br>(CEO-student) | t<br>value         |
|---|---------------------------|-------|--------------------------------------|-------|-----------------|------------------------------|--|--------------------|
| Maximize profits over the short run                     | 2.82                      | 0.951 | 2.75                                 | 1.00  | 20              | 19                           | -0.07                                      | -1.03              |
| Survival  | 1.49                      | 0.805 | 1.65                                 | 0.983 | 2               | 2                            | 0.16                                       | 2.42 <sup>b</sup>  |
| Be of service to the community                          | 2.61                      | 0.825 | 2.85                                 | 0.872 | 19              | 20                           | 0.23                                       | 3.44 <sup>a</sup>  |
| Be the leading innovator in the industry                | 2.24                      | 0.917 | 2.03                                 | 0.855 | 16              | 9                            | -0.21                                      | -3.14 <sup>a</sup> |
| Maximize profits over the long run                      | 1.39                      | 0.848 | 1.33                                 | 0.880 | 1               | 1                            | -0.06                                      | -0.87              |
| Be a socially responsible company                       | 2.10                      | 0.865 | 2.48                                 | 0.933 | 12              | 15                           | 0.37                                       | 4.90 <sup>a</sup>  |
| Provide high rewards and benefits to employees          | 2.21                      | 0.842 | 2.54                                 | 0.826 | 14              | 16                           | 0.31                                       | 4.91 <sup>a</sup>  |
| Maximize the company's net assets and reserves          | 2.22                      | 0.793 | 2.17                                 | 0.917 | 15              | 11                           | -0.05                                      | -0.91              |
| Create a pleasant and friendly workplace                | 2.07                      | 0.928 | 2.55                                 | 0.885 | 11              | 17                           | 0.47                                       | 6.67 <sup>a</sup>  |
| Have satisfied employees                                | 1.81                      | 0.938 | 2.19                                 | 0.953 | 4               | 12                           | 0.36                                       | 4.78 <sup>a</sup>  |
| Keep tax payments to a minimum                          | 2.54                      | 0.944 | 2.26                                 | 0.976 | 17              | 13                           | -0.27                                      | -3.71 <sup>a</sup> |
| Maximize the company's rate of growth                   | 2.00                      | 0.868 | 1.94                                 | 0.898 | 9               | 7                            | -0.05                                      | -0.89              |
| Increase sales growth                                   | 1.84                      | 0.833 | 1.81                                 | 0.812 | 5               | 3                            | -0.03                                      | -0.49              |
| Provide the best quality products and services possible | 1.68                      | 0.893 | 1.84                                 | 0.930 | 3               | 4                            | 0.16                                       | 2.03 <sup>b</sup>  |
| Be a market leader in your respective market(s)         | 2.00                      | 0.892 | 1.87                                 | 0.855 | 9               | 5                            | -0.12                                      | -1.71 <sup>c</sup> |
| Maximize dividends for the shareholders                 | 2.59                      | 0.945 | 2.42                                 | 0.970 | 18              | 14                           | -0.16                                      | -2.37 <sup>b</sup> |
| Run a stable organization                               | 1.97                      | 0.794 | 2.04                                 | 0.817 | 6               | 10                           | 0.06                                       | 1.02               |
| Maximize the market share                               | 1.98                      | 0.894 | 1.90                                 | 0.821 | 7               | 6                            | -0.08                                      | -1.24              |
| Run an ethical organization                             | 2.15                      | 0.891 | 2.55                                 | 0.858 | 13              | 18                           | 0.40                                       | 5.76 <sup>b</sup>  |
| Achieve business goals through financial objectives     | 2.06                      | 0.815 | 2.02                                 | 0.909 | 10              | 8                            | -0.03                                      | -0.49              |

Figure 9: Fulmer's Business Goals [Beggs 1989]

#### A.4 Marketing Strategies

Michael Porter has written a panoply of books on competitive strategy. He outlines the following marketing strategies for corporations [Porter 1998]:

- cost leadership. The company aims at providing the product at the lowest possible cost.
- differentiation. The products of the company differ by a certain aspect (e.g., service, brand name, etc.) from the products of the competition.
- focusing. The company focuses on a specific niche (providing better products/service there).

Also identified are a number of ways in which IT systems can bring about process innovation. These include

- replacement of labor by automation
- diversification of operational sequence
- elimination of intermediate stages
- automatic tracking of business events

- collection, communication, and retrieval of operational knowledge
- improvement of decision making
- coordination across distance
- alignment between task and process
- management on basis of process measurements

These represent business goals that we can add to the ones offered by authors cited in previous subsections.

## **A.5 What Drives Business Models**

De Reuver, Bouwman, and MacInnes conducted a study of how a start-up organization's business models change over time and the factors that drive that change [de Reuver 2007]. Synthesizing definitions from other authors, they say that a business model is “a blueprint for the way a business creates and captures value from new services or products” [Chesbrough 2002]. A business model “describes how a company or network of companies aims to make money and create consumer value” [Faber 2003]; it is “an abstract representation of how organizations create value [Seddon 2003]. Thus, business models seem closely related to business goals.

De Reuver and colleagues' objective was to find which external drivers are most relevant throughout the phases of the business model life cycle. They concluded that technology and market drivers are most relevant during initial development of service concept and underlying technology. Regulatory drivers seemed to play a minor role through the life cycle, headline cases like Napster notwithstanding. Business model dynamics seem much more applicable for business models centered on small, start-up companies than for large, established businesses. For the latter, the role of these drivers appears to remain steady throughout the phases.

The conclusion is that one needs to focus on technology and market forces most in the first phase, especially in a start-up. Figure 10 summarizes the way that external drivers come to bear on business models over time.

Chesbrough provides a useful and readable overview of business models and their use [Chesbrough 2007]. Seddon and Lewis provide a similarly helpful overview by way of distinguishing the concept of “business model” from that of “strategy” [Seddon 2003].

If we interpret “value” generally, beyond just making money, then business models can exist to serve ethical goals. For example, Stubbs and Cocklin write about and present examples of business models where environmental and social sustainability concepts shape the driving force of the firm and its decisions [Stubbs 2008], and their paper includes references to other work in this area.

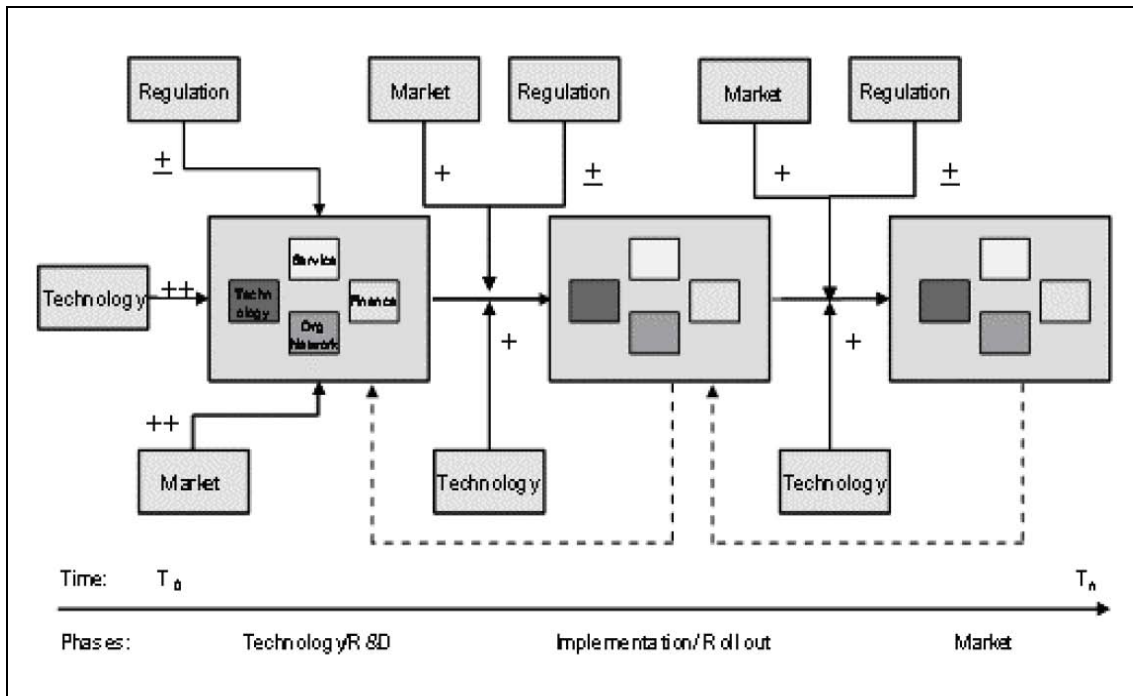


Figure 10: Drivers of Business Model Change [de Reuver 2007]. The four boxes inside each instance of the business model denote the four areas a business model must address: service, financial, organization, and technology.

## A.6 An Ontology for Business Models

Osterwalder and Pigneur created an ontology for business models for e-business firms. For them, a business model is “nothing else than a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams” [Osterwalder 2004].<sup>8</sup> A business model describes the logic of a “business system” for creating value that lies behind the actual processes [Petrovic 2001].

After an extensive literature search, Osterwalder and Pigneur concluded that business models are constructed around products, customers, infrastructures, and financial issues. As shown in Figure 11, they interpret business models as the conceptual link between strategy, business organization, and technology. Because there is often quite a substantial gap in understanding between these “worlds,” a business model can serve as a common frame of reference or communication vehicle. The role of the manager, they say, is to adapt a company’s business model to external forces, such as competition, legal, social, or technological change and changes in customer demand [Osterwalder 2004].

<sup>8</sup> These authors apparently consider altruistic aims (such as Usunier’s “ethics” goals) to be invalid parts of a business model, unless those aims serve “customers.” That seems short sighted, especially given the plethora of literature showing that organizations focused on social goals outperform those fixated on profit [Bernárdez 2005].

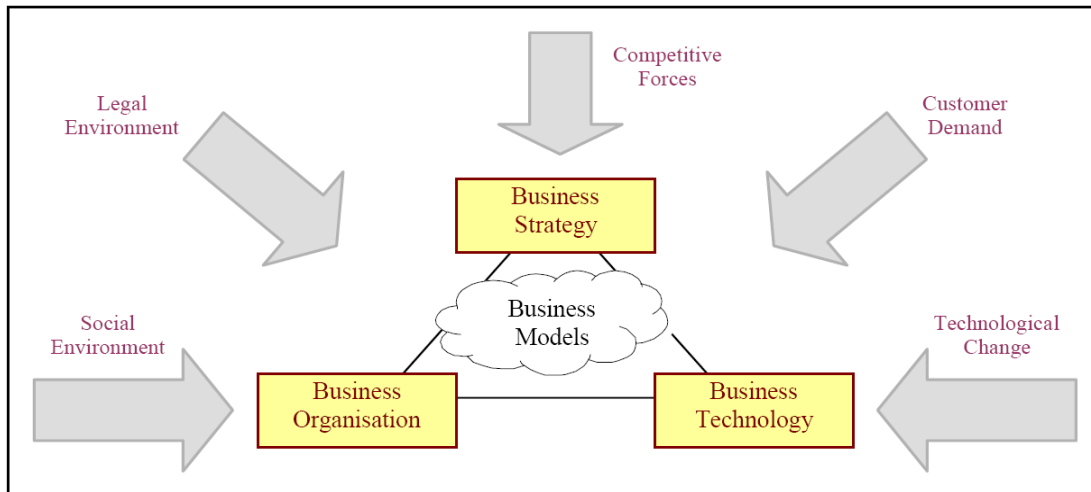


Figure 11: Business Models Lie at the Intersection of Strategy, Organization, and Technology [Osterwalder 2004]

Although Figure 11 is merely the prelude for Osterwalder and Pigneur’s ontology, we can use it as an eight-way classification of business goals. According to this classification, an organization can (and should) have goals to control or adapt to each of the five environmental factors plus goals to manage its own organization, strategy, and technology. For example, goals to manage the environmental factors could be constructed as follows:

1. operate effectively within legal environment
2. operate effectively within social environment
3. operate effectively within competitive environment
4. operate effectively within technological environment
5. operate effectively within customer environment

Osterwalder and Pigneur begin their ontology by naming four “pillars” or business model “blocks”:

1. The *product innovation block* describes the value proposition of a firm.
2. The *customer relationship block* describes how a firm gets in touch with its customers and the kind of relationships it wants to establish with them.
3. The *infrastructure management block* describes the activities, resources, and partners necessary to provide the first two blocks.
4. The *financial aspects block* describes the revenue flows and the pricing mechanisms of a firm, or, in other words, how a company makes money through the other three blocks.

Each of these is further decomposed into constituent elements and interrelationships. For example, one element of the product innovation block is the *value proposition* for a product offering. Figure 12 shows the associated definitions in the ontology. Figure 13 shows the definition applied to a fictional credit card company.

|   |
|---|
| <p style="text-align: center;"><b>VALUE PROPOSITION</b></p> <p>A <i>VALUE PROPOSITION</i> is an overall view of a firm's bundle of products and services that together represent a value for a specific <i>CUSTOMER SEGMENT</i>.</p> <ul style="list-style-type: none"> <li>• It represents value for <i>TARGET CUSTOMER(s)</i>.</li> <li>• It is based on <i>CAPABILITY(ies)</i>.</li> </ul> <p>It is composed of a set of one or more <b>OFFERING(s)</b>.</p> <p style="text-align: center;"><b>OFFERING</b></p> <p>An <i>elementary OFFERING</i> describes a part of a firm's bundle of products and services.</p> <ul style="list-style-type: none"> <li>• It has a <i>DESCRIPTION</i>.</li> <li>• It has a <i>REASONING</i> {USE, RISK REDUCTION, EFFORT REDUCTION}.</li> <li>• It has a <i>LIFE CYCLE</i> {CREATION, APPROPRIATION, CONSUMPTION, RENEWAL, TRANSFER}.</li> <li>• It has a <i>VALUE LEVEL</i> {ME-TOO, INNOVATIVE INNOVATION, EXCELLENCE, INNOVATION}.</li> <li>• It has a <i>PRICE LEVEL</i> {FREE, ECONOMY, MARKET, HIGH-END}.</li> </ul> |
|---|

Figure 12: The Ontology Definition for Value Proposition and Offering [Osterwalder 2004]

|                         | Card Builder  | Personalized credit card   | Online account management   |
|-------------------------|---|--|---|
| <b>Description</b>      | With the so-called Card Builder customers can select their own individual combination of interest rate, cashback rewards, annual fee and servicing options. They build their own personalized credit card | The easyMoney.com credit card is accepted at over 19.1 million locations worldwide displaying the MasterCard logo and is financially attractive. | Customers can handle their account online and receive their statements electronically. At every moment they have an up to date overview of their account history. |
| <b>Reasoning</b>        | A customized credit card reduces the financial risk of paying for options the customer doesn't need nor use.  | By configuring his own credit card the customer benefits from attractive prices because he pays for what he gets.                                | Clients can conveniently manage their accounts from their PC and profit from lower handling costs.  |
| <b>Value life cycle</b> | Value creation  | Value Consumption  | Value Consumption   |
| <b>Value level</b>      | Innovation  | Innovation   | Innovation/me-too   |
| <b>Price level</b>      | free  | economy  | free  |

Figure 13: An Example of a Value Proposition for a Firm's Offerings

## A.7 Assessing Technology Risk

The previous two works both mention technology as a critical environmental factor that drives business models. Bodde provides a simple but useful framework to help set forth that factor; the

framework takes the form of a 2x2 matrix [Bodde 2007]. The top row lists technologies that attack or undermine the current business model—that is, these technologies pose a risk to business as usual. The bottom row lists technologies that reinforce the current business model. The left column is for technologies with low probability of performance growth, whereas the right is for those with significant potential for growth. Figure 14 shows an example of technologies affecting regulated power (electrical) utility companies. The northeast quadrant represents the biggest “threat” technologies—those with high growth potential that undermine the current business model.

|   |   |  |
|---|---|--|
| <b>Prevailing Business Model</b><br><br><b>Attacked</b><br><br><br><b>Reinforced</b>                  | <i>What... me worry?</i> <ul style="list-style-type: none"> <li>• Rooftop photovoltaics</li> <li>• Independent power producers</li> </ul> | <i>Paradise Lost</i> <ul style="list-style-type: none"> <li>• Fuel cells</li> <li>• Digital grid control</li> <li>• IGCC</li> </ul>  |
|   | <i>The Quiet Life</i> <ul style="list-style-type: none"> <li>• Large scale pulverized coal</li> <li>• Light water reactor</li> </ul>      | <i>Paradise Gained</i> <ul style="list-style-type: none"> <li>• Gas-cooled nuclear reactor</li> <li>• Sequestration of CO<sub>2</sub></li> <li>• Fuel cells</li> <li>• Digital grid control</li> <li>• IGCC</li> </ul> |
| <div> <div>Low</div> <div>High</div> </div> <b>Potential for Performance Growth of the Technology</b> |   |  |

Figure 14: Example of Matrix to Help Determine Technology Risk Factor [Bodde 2007]

## A.8 Seven Key Elements of a Business Model

Mitchell and Coles provide a useful framework for fleshing out a business model based on the venerable “who, what, when, where, why, and how” model (to which they add “how much”) [Mitchell 2003]:

1. “Who?” defines all the stakeholders you are serving or affecting.
2. “What?” describes the offerings and their benefits and negative influences that affect each stakeholder.
3. “When?” captures the timing of offerings’ effects on stakeholders.
4. “Where?” identifies the location for delivering benefits and other impacts.
5. “Why?” gives the rationale for providing the stakeholder benefits you deliver.
6. “How?” explains your method of providing your offerings and being compensated for them.
7. “How much?” states the price customers pay and the costs they incur.

This simple framework can help us ask stakeholders the right questions to elicit an organization’s business goals.

## A.9 Stakeholder Theory

A field of research in the business/management world called “stakeholder theory” views organizations (e.g., corporations) as a collection of stakeholders all working out their stakes with each other. Donaldson and Preston compare the traditional “input-output” model of a corporation with a stakeholder-centric view [Donaldson 1995].

Under the input-output model (Figure 15), investors, employees, and suppliers are depicted as contributing inputs, which the “black box” of the firm transforms into outputs for the benefit of customers. (Of course, each contributor of inputs expects to receive appropriate compensation.)<sup>9</sup>

**Contrasting Models of the Corporation: Input-Output Model**

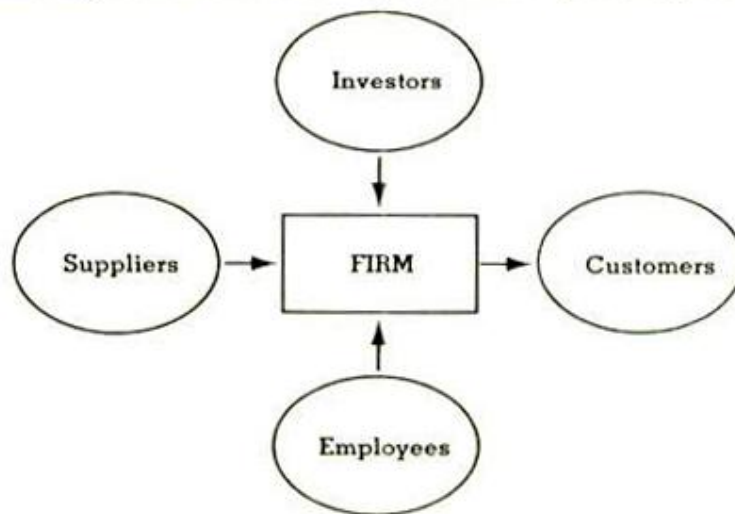


Figure 15: Input-Output Model of a Corporation [Donaldson 1995]

In the stakeholder model (Figure 16), all persons or groups with legitimate interests who participate in an enterprise do so to obtain benefits, and there is no *prima facie* priority of one set of interests and benefits over another. Hence, the input-output arrows between the firm and its stakeholder constituents run in both directions.

---

<sup>9</sup> Donaldson and Preston add an aside that is eerily prescient given the dire economic conditions at the time of this report: “There is, of course, a Marxist-capitalist version of this model in which both the customer and the investor arrows are reversed, and the object of the game is merely to produce benefits for the investors. This interpretation now seems to be confined almost exclusively to the field of finance.”

## Contrasting Models of the Corporation: The Stakeholder Model

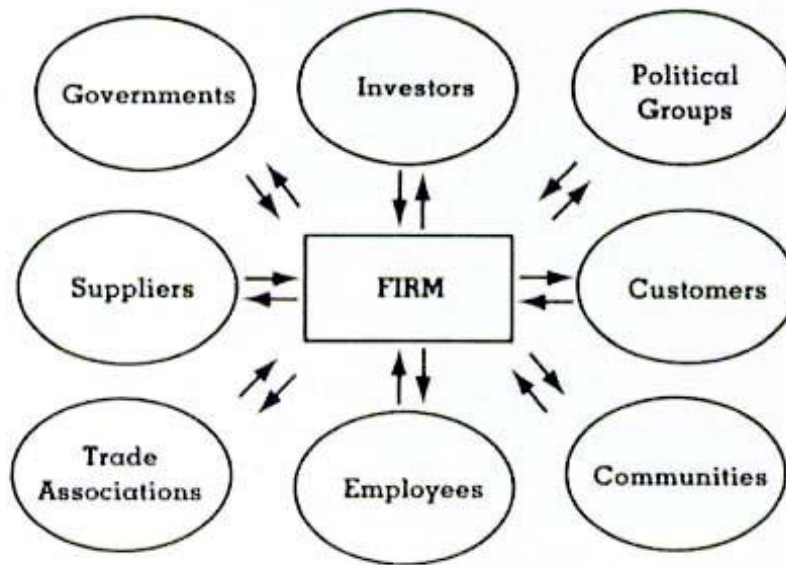


Figure 16: Stakeholder Model of a Corporation [Donaldson 1995]

A stakeholder is broadly viewed as “any group or individual who can affect or is affected by the achievement of the organization's objectives” [Freeman 1984]. Narrower definitions exist, however, that focus on stakeholders of the greatest importance.

Mitchell, Agle, and Wood do a thorough job of summarizing the field and laying out the foundations of a stakeholder theory [Mitchell 1997]. They posit that stakeholders have identifications and salience (importance). Stakeholders can be people, groups, neighborhoods, communities, even the natural environment. (Donaldson and Preston point out that under non-discrimination laws, even unsuccessful job applicants can be stakeholders in a corporation.) A stakeholder’s salience comes from its power, urgency, and legitimacy. Managers are the only stakeholders who have the ability to assign salience to the other stakeholders. Stakeholders can be latent, dormant, discretionary, demanding, expectant, dominant, dependent, dangerous, and definitive, where each of these is technically defined. Figure 17 summarizes the most important concepts and terms.



| Key Constructs in the Theory of Stakeholder Identification and Salience |  |   |
|---|--|---|
| Construct   | Definition   | Sources   |
| Stakeholder   | Any group or individual who can affect or is affected by the achievement of the organization's objectives  | Freeman, 1984; Jones, 1995; Kreiner & Bhambri, 1988   |
| Power   | A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done   | Dahl, 1957; Pfeffer, 1981; Weber, 1947  |
| Bases   | Coercive—force/threat<br>Utilitarian—material/incentives<br>Normative—symbolic influences  | Etzioni, 1964   |
| Legitimacy  | A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions                            | Suchman, 1995; Weber, 1947  |
| Bases   | Individual<br>Organizational<br>Societal   | Wood, 1991  |
| Urgency   | The degree to which stakeholder claims call for immediate attention  | Original—builds on the definition from the Merriam-Webster Dictionary   |
| Bases   | Time sensitivity—the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder<br>Criticality—the importance of the claim or the relationship to the stakeholder | Eyestone, 1978; Wartick & Mahon, 1994<br>Original—asset specificity from Hill & Jones, 1992; Williamson, 1985 |
| Salience  | The degree to which managers give priority to competing stakeholder claims   | Original—builds on the definition from the Merriam-Webster Dictionary   |

Figure 17: Key Constructs in Mitchell and Colleagues' Stakeholder Theory [Mitchell 1997]

Mitchell and colleagues refer to their theory as defining the “Principle of Who and What Really Counts,” a phrase of earlier provenance [Freeman 1994]. Donaldson and Preston, as well as Freeman, argue that the stakeholder role is “managerial”—that is, it imposes obligations and opportunities on management—and recommend “managerial attitudes, structures, and practices that, taken together, constitute a stakeholder management philosophy” [Donaldson 1995].

Stakeholder theory gives us another way to view business goals by categorizing them according to the stakeholders who own them.

## A.10 Changing Business Models Can Define an Industry

In 2007 IBM and the Economist Intelligence Unit polled 252 executives from the telecom industry to obtain their views on some of the current business themes in the industry [McIntosh 2007]. These themes included future sources of value, customer service, and revenue growth; the role and significance of advertising; the “distinctive capabilities” of the telecom provider; delivering on the next-generation network; service management as a differentiator, and the future

of global sourcing. Forty percent of the respondents were drawn from Western Europe, 30 percent from North America, 20 percent from Asia-Pacific, and 10 percent were from the rest of the world.

The number one finding of the 2007 survey is that the source of value perceived as primary is business model transformation. Business model transformation handily beat out such old-school standbys as cost reduction and revenue growth. Figure 18 summarizes the survey results.

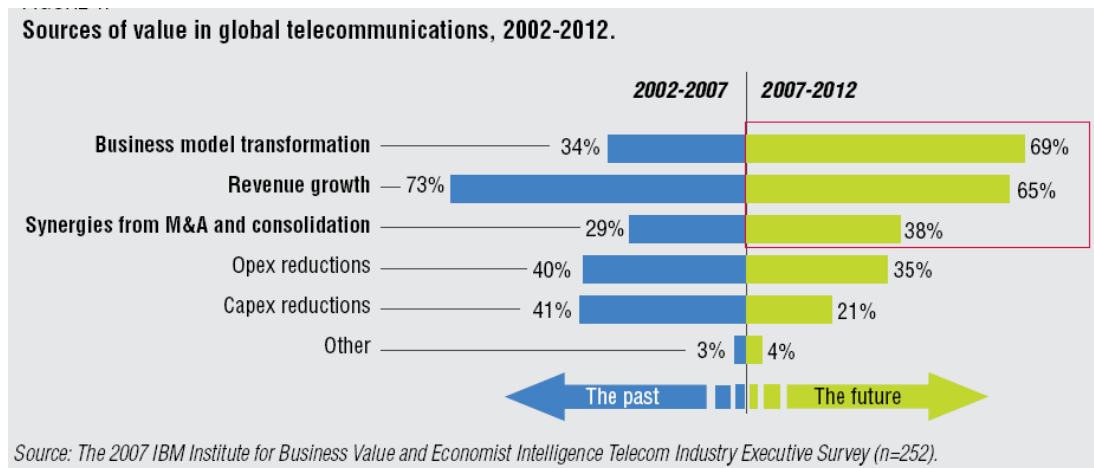


Figure 18: Summary of Telecom Industry Survey Results [McIntosh 2007]

Five years ago, only 34 percent of telecom providers singled out business model transformation as a source of value.

While many business-school authors preach business model agility as the key to a firm's survival and success, here is a concrete example where changing business models represent an industry-wide reality. For us, this is relevant because if we are going to ask an architect to be sensitive to his or her organization's business model, we must also ask the architect to be prepared to respond to a fundamental change in that business model.

#### A.11 Business Goals Collected from Architecture Evaluations

In a software architecture evaluation using the SEI Architecture Tradeoff Analysis Method (ATAM) [Clements 2003], one of the steps is for the system's customer or the development organization's project manager to describe the business goals that are driving the acquisition or development of the system. In a study of the results of dozens of such evaluations using the ATAM, Kazman and Bass summarized and categorized the business goals that emerged [Kazman 2005]. The categories they identified are shown in Table 4.

Table 4: Business Goal Categories from Bass and Kazman [Kazman 2005]

| Category   | Sample goals  |   |
|--|---|---|
| <b>Reduce Total Cost of Ownership.</b> This category includes business goals of reducing overall cost or reducing the cost of specific parts of the life cycle, such as development, deployment, maintenance, and retirement.  | Reduce Cost of Development  | Manage flexibility, distributed development, portability, open systems/standards, testability, product lines, integrability, interoperability |
|  | Reduce Cost of Deployment and Operations  | Ease of installation and ease of repair   |
|  | Reduce Cost of Maintenance  | Flexibility/configurability   |
|  | Reduce Cost of Retirement or Moving to a New System   | Retiring systems, smooth transition to follow-on systems, and replace legacy systems  |
| <b>Improve Capability/Quality of System.</b> Business goals in this category refer to the improvement of a system capability or quality compared to prior versions of the same system or contrasted with the system(s) being replaced.   | Performance, reliability/availability, product lines, ease of use, security, safety, scalability/extendibility, functionality, system constraints, internationalization |   |
| <b>Improve Confidence in and Perception of the System.</b> This category includes goals intended to enhance the reputation of the developing organization.   | Maintain or improve reputation  |   |
| <b>Support Improved Business Processes.</b> This category of business goals is concerned with improving the internal business processes and the structure of the organization. Goals here include supporting distributed development, and maintaining jobs of the workforce on legacy systems. | Distributed development, maintain jobs of workforce on legacy systems   |   |
| <b>Improve Market Position.</b> Goals in this category have to do with market position or timing.  | Expand or retain market share, maintain or improve reputation, enter new markets, reduce time to market   |   |

This grouping is based on field observation of what people have reported to be the business goals of systems. The categories were created with an affinity exercise conducted by the authors after examining the raw data. There are obvious relationships and overlaps among the categories: for example, increasing the capability or quality of one's product(s) is a good way to increase market share.

Unlike all of the other resources in this section, the Kazman and Bass goal categories are the only ones drawn purely from empirical sampling. Thus, they are a bit scattered across the map, a function of uneven elicitation by different facilitators during ATAM exercises. The first three are about goals directly tied to the system being developed, whereas the goals we've seen in previous subsections seem more organizational in nature. This dichotomy is glaring in the Kazman and Bass goals, and non-existent in the other authors' catalogs.

## A.12 Business Goals in a Multi-Project (Portfolio) Context

Many, if not most, organizations manage a multitude of related projects simultaneously. Archer and Ghasemzadeh define a project portfolio as "a group of projects that are conducted under the sponsorship or management of a particular organization" [Archer 1999]. They point out that these projects compete for scarce resources. The goals of the individual projects can be influenced by each other and by the goals of the organization at large, and shrewd organizations manage their

portfolios as well as their projects. Portfolio management is “the art and science of applying a set of knowledge, skills, tools, and techniques to a collection of projects to meet or exceed the needs and expectations of an organization’s investment strategy” [Dye 1999].

Artto and Dietrich provide a literature summary of the business goals (described as “dimensions of project success”) of portfolio-managing organizations [Artto 2007]. They include

- Cooper, Edgett, and Kleinschmidt, 1998
  - maximizing the value of the portfolio
  - linking the portfolio to the strategy
  - balancing the portfolio
- Shenhar, Levy, and Dvir, 1997
  - project efficiency
  - impact on customer
  - business success
  - preparing for the future
- Saravirta (2001) and Kotsalo-Mustonen (1996)
  - strategy (e.g., new competitive advantage, reference value)
  - relationship (e.g., client satisfaction)
  - situation (e.g., learning by doing, unlearning)
  - product/service (e.g., commercial success, quality)
  - project implementation (e.g., cost, time, process quality)
- Morris and Hough (1987) and Rouhiainen (1997)
  - technical performance, project functionality, client satisfaction, and technical and financial performance of the deliverable for the sponsor/customer
  - project management: on budget, on schedule, and to technical specification
  - supplier’s commercial performance: commercial benefit for the project service providers
  - the learning that project stakeholders acquire

### **A.13 Project Types Influence Business Goals**

Artto and Dietrich present the argument that projects of different types will have different business goals. Project types differ in their strategic importance, they say, and each type typically requires a different management approach [Artto 2007].

Crawford, Hobbs, and Turner, as well as Shenhar, Levy, and Dvir, and Youker conducted studies of project classification that attempt to address this issue. These are valuable for understanding not only different project types and their characteristics but also the different success criteria and their strategic importance and, accordingly, different successful managerial practices associated with each project type [Crawford 2002, Shenhar 2002, Youker 1999].

Shenhar and colleagues classify projects into external and internal types, where the position or closeness of the customer (external or internal) provides the basis for the classification. This classification also considers the ultimate customer in the external markets in relation to how direct or indirect the relationship of the ultimate customer is to the project deliverable [Shenhar 2002].

Their starting point is innovation management literature that makes a distinction between incremental and radical innovation. Thus, according to Shenhar and colleagues, projects can be either *strategic* or *operational* in their nature, depending on the project type.

External projects typically relate to developing products for customers in the market. Shenhar's study distinguishes among external projects as derivative, platform, and breakthrough projects [Shenhar 2002]. Wheelwright and Clark call these three project types *commercial development projects* [Wheelwright 1992]. Based on Shenhar and colleagues' considerations, derivative projects relate to extending, improving, or upgrading existing products. They typically aim at short-term benefits, and they are thus more operational than strategic in their nature. Platform and breakthrough projects relate to new product development or production processes where there is a longer term perspective, and, accordingly, more striving for strategy.

Another interpretation of an external project is that of a delivery project where the project is in a commercial setting and where an organization is running projects for other organizations [Turner 1999]. Such external-delivery projects are often mere production or manufacturing devices that run more or less predetermined work for an organization according to a contract between the customer and project supplier [Artto 2001]. The similarity of project-based operations for both external and internal customers is demonstrated by Turner and Keegan, who defined a project-based organization as a stand-alone entity that makes products for external customers, or a subsidiary of a business unit of a larger firm that makes products for internal or external customers [Turner 1999].

Shenhar and colleagues divide internal projects into problem solving, utility, maintenance, and research projects [Shenhar 2002]. Wheelwright and Clark distinguish between internal projects based on research and development, which are a precursor to commercial development, and alliances and partnerships, which can be commercial or basic research directed [Wheelwright 1992]. Figure 19 describes their view on different types of development projects (the figure includes four types; the fifth type—alliances and partnerships—can include any of the other four types). Mikkelsen and colleagues define internal projects as organizational or operational development projects, such as systems planning and implementation, the introduction of new manufacturing technology, and organizational change [Mikkelsen 1991]. Shenhar and colleagues' utility and research projects usually come from a long-term perspective and can be considered as strategic projects. Problem-solving and maintenance projects usually focus on the shorter term, typically aim at performance improvements, and can be seen as operational projects [Shenhar 2002].

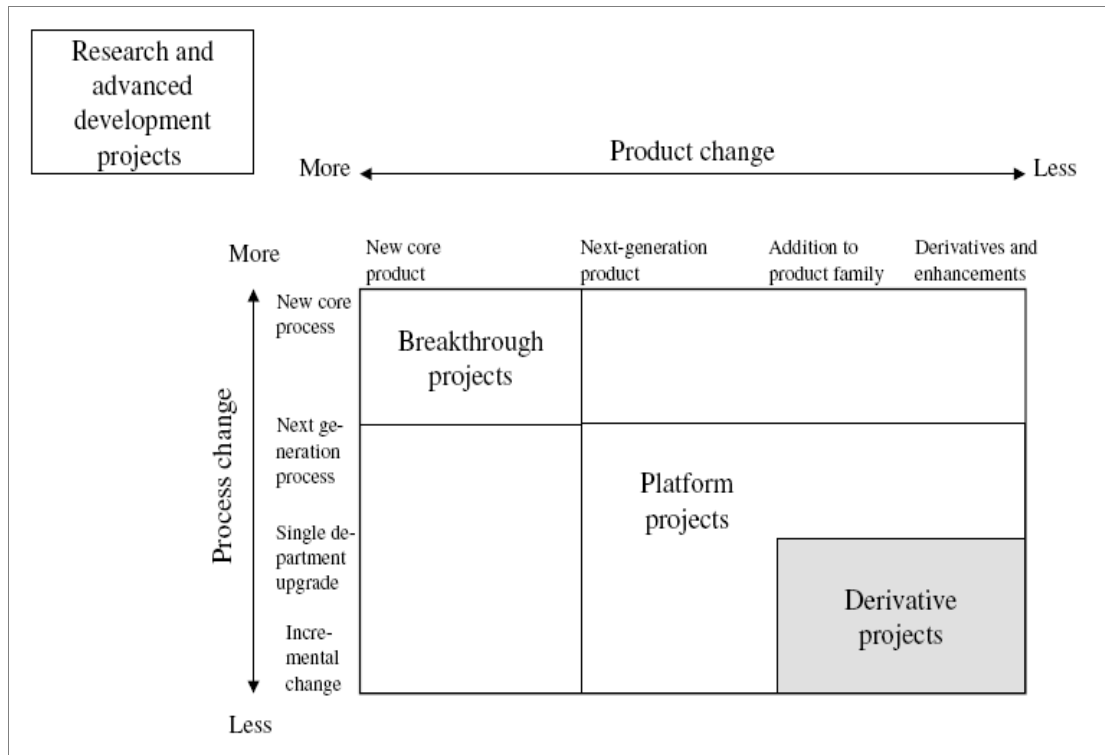


Figure 19: Projects Can Be Classified by How Much They Change Existing Products and Processes [Wheelwright 1992, Artto 2007]

#### A.14 Enterprise Architecture and TOGAF

Enterprise architecture may be seen as establishing a processing environment in which an organization's business goals can be carried out. Therefore, enterprise architects are keenly interested in capturing and expressing such goals. This interest is captured in the Architecture Development Method (ADM) of The Open Group Architecture Framework (TOGAF) [TOGAF 2009].

Part III of the TOGAF ADM includes a treatment of business scenarios, which is its vehicle for capturing and expressing business goals. According to TOGAF, "a business scenario is essentially a complete description of a business problem, both in business and in architectural terms, which enables individual requirements to be viewed in relation to one another in the context of the overall problem."

TOGAF's purpose for capturing business goals for the enterprise architect mirrors our own purpose for the software architect. Without such a purpose,

- "There is a danger of the architecture being based on an incomplete set of requirements that do not add up to a whole problem description, and that can therefore misguide architecture work.
- "The business value of solving the problem is unclear.
- "The relevance of potential solutions is unclear.

TOGAF also touts business scenarios as way to increase stakeholder communication and buy-in.

A good business scenario is

- **Specific:** It defines what needs to be done in the business.
- **Measurable:** It includes clear metrics for success.
- **Actionable:** It clearly segments the problem and provides the basis for determining elements and plans for the solution.
- **Realistic:** The problem can be solved within the bounds of physical reality, time, and cost constraints.
- **Time-bound:** There is a clear statement of when the solution opportunity expires.

These criteria are abbreviated as “SMART.” Creating a business scenario involves the following:

1. identifying, documenting, and ranking the problem driving the scenario
2. identifying the business and technical environment of the scenario and documenting it in scenario models
3. identifying and documenting desired objectives (the results of handling the problems successfully)
4. identifying the human actors and their place in the business model
5. identifying computer actors and their place in the technology model
6. identifying and documenting roles, responsibilities, and measures of success per actor; documenting the required scripts per actor, and the results of handling the situation
7. checking for “fitness-for-purpose” and refining only if necessary

## A.15 Summary of This Section

Table 5 shows how the works cited in this section helped us build an approach to eliciting well-articulated business goals, which we can then use to build a high-fidelity list of quality attribute requirements.

*Table 5: Summary of Related Work*

| Related work                    | Summary  | How it helps elicit business goals                                 |
|---------------------------------|--|--|
| Cross-national business goals   | The “Hofstede goals,” a widely cited classification of business goals  | Checklist: Do any of these business goals apply to your situation? |
| Ethical vs. self-interest goals | Identified a set of “ethical” and “self-interest” business goals   |  |
| Business goals for CEOs         | The “Fulmer goals,” a widely cited classification of business goals  |  |
| Marketing strategies            | Major strategies are cost leadership, differentiation, and focusing. Also, IT systems can be about process innovation, such as replacement of labor by automation. |  |
| Business goals collected from   | Catalogued and categorized the business  |  |

|   |   |  |
|---|---|--|
| architecture evaluations                        | goals identified in dozens of ATAM-based engagements  |  |
| What drives business models                     | Technology, market, and regulatory drivers play a role throughout a business model's life cycle.  | How do these drivers affect your business goals (especially if your organization is a start-up)?                                       |
| An ontology for business models                 | <p>Ontology consists of four “pillars” (each later elaborated with a meta-model):</p> <ol style="list-style-type: none"> <li>1. Product innovation block describes the value proposition of a firm.</li> <li>2. Customer relationship block describes how a firm gets in touch with its customers and what kind of relationships to establish with them.</li> <li>3. Infrastructure management block describes what activities, resources, and partners are necessary to provide first two blocks.</li> <li>4. Financial aspects block describes the revenue flows and the pricing mechanisms of a firm.</li> </ol> | How do these pillars affect your business goals?   |
| Managing technical risk                         | 2x2 matrix to help reason about technology drivers behind business goals  | Do near-term technologies reinforce or undermine your business goals?  |
| Seven Key Elements of a Business Model          | Defined questions about business goals in terms of who, what, when, where, why, how, and how much   | Can you answer these questions for your business goals?  |
| Stakeholder theory                              | Elaborates on the “who” of Mitchell and Coles   | Who are your empowered stakeholders and what are their goals? Begin with the stakeholders listed in this paper, and then add your own. |
| Changing business models can define an industry | In 2007, the largest perceived source of value in telecomm was changing business models.  | How is your business model likely to change over the foreseeable future?   |
| Goals for portfolios                            | Projects that are part of a portfolio tend to have business goals particular to the portfolio.  | Is your system part of a portfolio? Do any of the usual portfolio-related business goals apply?  |
| Project type influences business goals          | Projects can be external, internal, platform, breakthrough, strategic, and so on.   | Which type is your project? Can we use that to elicit business goals based on its type?  |
| TOGAF   | Capturing business goals using scenarios for enterprise architects  | What are the actors, the environment, objectives, success measures, and ranking of your business goals?                                |





---

## References

*URLs are valid as of the publication date of this document.*

### **[American Heritage 2010]**

American Heritage. *The American Heritage Dictionary of Business Terms*. Houghton Mifflin Harcourt Publishing Company, 2010. <http://www.yourdictionary.com/business/goal>

### **[Antón 1997]**

Antón, Annie I. “Goal Identification and Refinement in the Specification of Information Systems,” PhD diss., Georgia Institute of Technology, June 1997.

### **[Archer 1999]**

Archer, N. P. & Ghasemzadeh, F. “An Integrated Framework for Project Portfolio Selection.” *International Journal of Project Management* 17, 4: 207–216, 1999.

### **[Artto 2001]**

Artto, K. A. “Management of Project-Oriented Organisation: Conceptual Analysis.” In *Project Portfolio Management: Strategic Management Through Projects*, Edited by K. A. Artto, M. Martinsuo, and T. Aalto, 5-20. Project Management Association Finland, 2001.

### **[Artto 2007]**

Artto, Karlos A. & Dietrich, Perttu H. “Strategic Business Management through Multiple Projects,” in *Wiley Guide to Managing Projects*. John Wiley & Sons, Inc, 2007.  
Available through <http://www3.interscience.wiley.com/cgi-bin/summary/116841851/SUMMARY>

### **[Barbacci 2003]**

Barbacci, M.; Ellison, R.; Lattanze, A.; Stafford, J.; Weinstock, C.; & Wood, W. *Quality Attribute Workshops, Third Edition* (CMU/SEI-2003-TR-016). Software Engineering Institute, Carnegie Mellon University, 2003. <http://www.sei.cmu.edu/library/abstracts/reports/03tr016.cfm>

### **[Bass 2003]**

Bass, Len; Clements, Paul; & Kazman, Rick. *Software Architecture in Practice*, Addison-Wesley, 2003.

### **[Beggs 1989]**

Beggs, J. M. & Lane, M. S. “Corporate Goal Structures and Business Students: A Comparative Study of Values.” *Journal of Business Ethics*, 8, 6: 471-478, 1989.

### **[Bergey 2009]**

Bergey, J.; Blanchette, S.; Clements, P.; Gagliardi, M.; Wojcik, R.; Wood, W.; & Klein, J. *U.S. Army Workshop on Exploring Enterprise, System of Systems, System, and Software Architectures* (CMU/SEI-2009-TN-028). Software Engineering Institute, Carnegie Mellon University, 2009. <http://www.sei.cmu.edu/library/abstracts/reports/09tr008.cfm>

**[Bernárdez 2005]**

Bernárdez, Mariano. "Achieving Business Success by Developing Clients and Community: Lessons from Leading Companies, Emerging Economies and a Nine Year Case Study." *Performance Improvement Quarterly* 18, 3: 37, 2005.

**[Bodde 2007]**

Bodde, David L. "Future Imperfect: Managing Strategic Risk In an Age of Uncertainty." *Public Utilities Fortnightly* 145, 1 (Jan 2007): 24.

**[Carroll 1979]**

Carroll, A. B. "A Three-Dimensional Conceptual Model of Corporate Performance." *Academy of Management Review* 4, 4: 497-505, 1979.

**[Carroll 1991]**

Carroll, A. B. "The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders." *Business Horizons* 34 (July-August 1991): 39-48.

**[Chesbrough 2007]**

Chesbrough, Henry. "Business Model Innovation: It's Not Just About Technology Anymore." *Strategy & Leadership* 35, 6: 12-17. Emerald Group Publishing Limited, 2007. ISSN 1087-857.

**[Chesbrough 2003]**

Chesbrough, H. & Rosenbloom, R. S. "The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spin-Off Companies." *Industrial and Corporate Change* 11, 3: 529-555, 2002.

**[Clements 2002]**

Clements, P. & Northrop, L. *Software Product Lines: Practices and Patterns*, Addison Wesley, 2002.

**[Clements 2003]**

Clements, P.; Kazman, R.; & Klein, M. *Evaluating Software Architectures: Methods and Case Studies*. Addison-Wesley, 2003.

**[Cooper 1998]**

Cooper, R. G.; Edgett, S. J.; & Kleinschmidt, E. J. *Portfolio Management for New Products*. Perseus Books, 1998.

**[Crawford 2002]**

Crawford, L.; Hobbs, J. B.; & Turner, J. R. "Investigation of Potential Classification Systems for Projects." 181-190. *PMI Research Conference 2002*. Seattle, WA, July, 2002. Project Management Institute, 2002.

**[de Reuver 2007]**

de Reuver, Mark; Bouwman, Harry; & MacInnes, Ian. "What Drives Business Model Dynamics? A Case Survey," *Eighth World Congress on the Management of eBusiness* (WCMeB 2007). Toronto, Canada, July 2007.

**[Donaldson 1995]**

Donaldson, Thomas & Preston, Lee E. "The Stakeholder Theory of the Corporation: Concepts, Evidence and Implications." *The Academy of Management Review* 20, 1 (Jan 1995): 65-91.

**[Dye 1999]**

Dye, L. D. & Pennypacker, J. S., eds. "An Introduction to Project Portfolio Management." *Project Portfolio Management: Selecting and Prioritizing Projects for Competitive Advantage*, Center for Business Practices, 1999.

**[EPF 2010]**

Eclipse Process Framework Project. *Concept: Architecturally Significant Requirements*. The Eclipse Foundation.

[http://epf.eclipse.org/wikis/epfpractices/core.tech.common.extend\\_supp/guidances/concepts/arch\\_significant\\_requirements\\_1EE5D757.html](http://epf.eclipse.org/wikis/epfpractices/core.tech.common.extend_supp/guidances/concepts/arch_significant_requirements_1EE5D757.html) (2010).

**[Faber 2003]**

Faber, E.; Ballon, P.; Bouwman, H.; Haaker, T.; Rietkerk, O.; & Steen, M. "Designing Business Models for Mobile ICT Services." In *16th Bled Electronic Commerce Conference eTransformation*. Bled, Slovenia, June, 2003.

**[Freeman 1984]**

Freeman, R. E. *Strategic Management: A Stakeholder Approach*. Pitman, 1984.

**[Freeman 1994]**

Freeman, R. E. "The Politics of Stakeholder Theory: Some Future Directions." *Business Ethics Quarterly* 4 (1994): 409-421.

**[Gross 2000]**

Gross, D. & Yu, E. "Evolving System Architecture to Meet Changing Business Goals: An Agent and Goal-Oriented Approach," 316-317. *Proceedings of the Fifth IEEE International Symposium on Requirements Engineering*, Toronto, Canada, August 2001. IEEE Computer Society, 2001 (ISBN-10: 0 7695 1125 2).

**[Harpell 1986]**

Harpell, John L. & Lane, Michael S. "Business Students Ethics as Reflected in Goal Selection." *Human Resources Management and Organizational Behavior Proceedings*, 1986.

**[Hofstede 2002]**

Hofstede, Geert; Van Deusen, Cheryl A.; Mueller, Carolyn B.; & Charles, Thomas A. "What Goals Do Business Leaders Pursue? A Study in Fifteen Countries." *The Business Goals Network Source: Journal of International Business Studies* 33, 4 (4th Qtr. 2002): 785-803. Palgrave Macmillan Journals, 2002.

**[Kazman 2005]**

Kazman, R. & Bass, Len. *Categorizing Business Goals for Software Architectures* (CMU/SEI-2005-TR-021). Software Engineering Institute, Carnegie Mellon University, 2005.  
<http://www.sei.cmu.edu/library/abstracts/reports/05tr021.cfm>

**[Kotsalo-Mustonen 1996]**

Kotsalo-Mustonen, A. "Diagnosis of Business Success: Perceptual Assessment of Success in Industrial Buyer-Seller Business Relationship." PhD diss., Helsinki School of Economics and Business Administration, Publications A-117, Helsinki, Finland, 1996.

**[Lane 1987]**

Lane, Michael S. & Harpell, John L. "Goals in Corporate America: A CEO perspective," *Northeast Decision Science Institute Proceedings*, March 1987.

**[Mäkinen 2007]**

Mäkinen, Saku & Seppänen, Marko. "Assessing Business Model Concepts with Taxonomical Research Criteria: A Preliminary Study." CITER Centre for Innovation and Technology Research, Institute of Industrial Management, Tampere University of Technology, Tampere, Finland. *Management Research News* 30, 10: 735-748. Emerald Group Publishing Limited, 2007 (0140-9174, DOI 10.1108/01409170710823458).

**[McIntosh 2007]**

McIntosh, Stuart & Nelson, Ekow. "Telecom Switches Emphasis: Preliminary Analysis of the 2007 Telecom Industry Survey." IBM Global Services, 2007.  
<http://www-935.ibm.com/services/us/index.wss/ibvstudy/gbs/a1029064>

**[McWilliams 2001]**

McWilliams, A., & Siegel, D. "Corporate Social Responsibility: A Theory of the Firm Perspective." *Academy of Management Review* 26, 1: 117-127, 2001.

**[Mikkelsen 1991]**

Mikkelsen, H.; Olsen W.; & Riis J. O. "Management of Internal Projects." *International Journal of Project Management* 9, 2: 77-81 1991.

**[Mitchell 2003]**

Mitchell, Donald W. & Coles, Carol Bruckner. "Building Better Business Models." *Leader to Leader* (Summer 2003): 12-17.

**[Mitchell 1997]**

Mitchell, Ronald K.; Agle, Bradley R.; & Wood, Donna J. "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts." *The Academy of Management Review* 22, 4 (Oct., 1997): 853-886. Academy of Management.  
<http://www.jstor.org/stable/259247>

**[Morris 2005]**

Morris; Peter W. G. & Jamieson, Ashley. "Moving from Corporate Strategy to Project Strategy." *Project Management Journal* 36, 4 (Dec. 2005): 5.

**[Morris 2007]**

Morris, P. & Hough, W.G. *The Anatomy of Major Projects: A Study of the Reality of Project Management*. Wiley, 2007.

**[Osterwalder 2004]**

Osterwalder, A. & Pigneur, Y. "An Ontology for e-Business Models," 65-97. *Value Creation from e-Business Models*. Edited by W. Currie. Butterworth-Heinemann, 2004.

**[Partington 2000]**

Partington, D. "Implementing Strategy Through Programmes of Projects," *Gower Handbook of Project Management*. Edited by Turner, J. R., Simister, S. J. Gower, 2000.

**[Petrovic 2001]**

Petrovic, O.; Kittl, C.; & Teksten, R. D. "Developing Business Models for eBusiness." *International Conference on Electronic Commerce*. Vienna, Austria, Nov. 2001.  
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.24.9466&rep=rep1&type=pdf>

**[Platje 1994]**

Platje, A.; Seidel, H.; & Wadman, S. "Project and Portfolio Planning Cycle: Project Based Management for Multi-Project Challenge." *International Journal of Project Management* 12, 2: 100-106.

**[Porter 1998]**

Porter, Michael E. "Competitive Strategy: Techniques for Analyzing Industries and Competitors." *Free Press* (June 1, 1998). (ISBN-10: 0684841487, ISBN-13: 978-0684841489).

**[Rouhiainen 1997]**

Rouhiainen P., *Managing New Product Development Implementation in Metal Industry*, Dissertation, Tampere University of Technology, Tampere, Finland, 1997.

**[Sangwan 2007]**

Sangwan, R. S. & Neill, C. J. "How Business Goals Drive Architectural Design." *Computer* 40, 8, (Aug. 2007): 85-87. IEEE (ISSN: 0018-9162).

**[Saravirta 2001]**

Saravirta, A. "Project Success Through Effective Decisions: Case Studies on Project Goal Setting, Success Evaluation, and Managerial Decision Making." PhD diss., Acta Universitatis Lappeenrantaensis 121, Lappeenranta University of Technology, Lappeenranta, Finland, 2001.

**[Seddon 2003]**

Seddon, P. B. & Lewis, G. P. "Strategy and Business Models: What's the Difference?" *7th Pacific Asia Conference on Information Systems*. Adelaide, South Australia, July 2003. PACIS, 2003.  
<http://www.pacis-net.org/index.jsp?t=proceeding&y=2003>

**[Shenhar 1997]**

Shenhar A. J.; Levy, O.; & Dvir, D. "Mapping the Dimensions of Project Success." *Project Management Journal* 28, 2:5-13, 1997.

**[Shenhar 2002]**

Shenhar, A. J.; Dvir, D.; Lechler, T.; & Poli, M. 2002. "One Size Does Not Fit All: True for Projects, True For Frameworks," 99-106. *PMI Research Conference*, Seattle, WA, July 2002. Project Management Institute, 2002.

**[Stubbs 2008]**

Stubbs, Wendy & Cocklin, Chris. "Conceptualizing a 'Sustainability Business Model,'" *Organization & Environment* 21, 2 (June 2008): 103-127. Sage Publications, 2008, (10.1177/1086026608318042). <http://oae.sagepub.com>

**[TOGAF 2009]**

*The Open Group Architecture Framework*, Version 9, 2009.  
<http://www.opengroup.org/architecture/togaf9-doc/arch>

**[Turner 1999]**

Turner, J. R. & Keegan, A. "The Management of Operations in the Project-Based Organization." *Managing Business by Projects I*: 57-85. Edited by K. A. Artto, K. Kähkönen, and K. Koskinen. Project Management Association Finland and Nordnet, 1999.

**[Usunier 2008]**

Usunier, Jean-Claude; Furrer, Olivier; & Perrinjaquet, Amandine. "Business Goals Compatibility: A Comparative Study." Institut de Recherche en Management (IRM), University of Lausanne, Ecole des HEC, Switzerland. 2008 Working Paper:  
[http://www.hec.unil.ch/irm/Research/Working Papers](http://www.hec.unil.ch/irm/Research/Working%20Papers)

**[van Lamsweerde 2001]**

van Lamsweerde, Axel. "Goal-Oriented Requirements Engineering: A Guided Tour" 249-268. *Proceedings, RE'01, 5<sup>th</sup> Intl. IEEE Symposium on Requirements Engineering*. Toronto, August 2001.

**[Velasquez 2006]**

Velasquez, D.A. & Weiss, M. "Goal-Oriented Design of Business Models and Software Architectures." *2006 Canadian Conference on Electrical and Computer Engineering*. May 2006, Ottawa, Canada. IEEE, 2007 (ISBN-10: 1 4244 0037 6).

**[Wheelwright 1992]**

Wheelwright, S. C. & Clark, K. B. "Creating Project Plans to Focus Product Development." *Harvard Business Review* (March-April): 70-82, 1992.

**[Youker 1999]**

Youker, R. "The Difference Between Different Types of Projects." *Proceedings of Project Management Institute Annual Seminars and Symposium*. Project Management Institute, 1999.

**[Yu 1998]**

Yu, Eric & Mylopoulos, John. "Why Goal-Oriented Requirements Engineering," 15-22. *Proceedings 4<sup>th</sup> Intl. Workshop on Requirements Engineering*, Pisa, Italy, June 1998. Presses Universitaires Namur, 1998.

| REPORT DOCUMENTATION PAGE  |  |   | Form Approved<br>OMB No. 0704-0188 |  |
|--|--|---|------------------------------------|--|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.   |  |   |                                    |  |
| 1. AGENCY USE ONLY<br>(Leave Blank)  | 2. REPORT DATE<br>May 2010                               | 3. REPORT TYPE AND DATES COVERED<br>Final                       |                                    |  |
| 4. TITLE AND SUBTITLE<br>Relating Business Goals to Architecturally Significant Requirements for Software Systems  |  | 5. FUNDING NUMBERS<br>FA8721-05-C-0003                          |                                    |  |
| 6. AUTHOR(S)<br>Paul Clements and Len Bass   |  |   |                                    |  |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br>Software Engineering Institute<br>Carnegie Mellon University<br>Pittsburgh, PA 15213   |  | 8. PERFORMING ORGANIZATION REPORT NUMBER<br>CMU/SEI-2010-TN-018 |                                    |  |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)<br>HQ ESC/XPK<br>5 Eglin Street<br>Hanscom AFB, MA 01731-2116  |  | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER                  |                                    |  |
| 11. SUPPLEMENTARY NOTES  |  |   |                                    |  |
| 12A DISTRIBUTION/AVAILABILITY STATEMENT<br>Unclassified/Unlimited, DTIC, NTIS  |  | 12B DISTRIBUTION CODE   |                                    |  |
| 13. ABSTRACT (MAXIMUM 200 WORDS)<br>The primary purpose of the architecture for a software-reliant system is to satisfy the driving behavioral and quality attribute requirements. Quality attribute requirements tend to be poorly captured and poorly represented in requirements specifications, which focus on functionality. It is often up to the architect's own initiative to capture the actual quality attribute requirements for a system under development. Quality attributes come about because of the business goals behind the system being developed. Business goals drive the conception, creation, and evolution of software-reliant systems. This report examines business goals from the point of view of the software architect. It presents a wide survey of business goal categories from the business literature and uses that survey to produce a classification of business goals. It introduces the concept of goal-subject (the person or entity who owns the business goal) and goal-object (the person or entity that the goal is intended to benefit). Those concepts are essential to the structure of a business goal scenario—a systematic way to elicit and express business goals. Using the concept of a business goal scenario drives the Pedigreed Attribute eLicitation Method (PALM), developed by the authors for eliciting architecturally significant business goals. The report illustrates how to use architecturally significant business goals to produce a set of derived quality attribute requirements that can then be vetted and elaborated with the appropriate goal-subject(s) and goal-object(s). This approach has been vetted in two workshops and the method piloted in an industrial setting. |  |   |                                    |  |
| 14. SUBJECT TERMS<br>Pedigreed Attribute Elicitation Method, PALM, business goal scenario  |  | 15. NUMBER OF PAGES<br>72                                       |                                    |  |
| 16. PRICE CODE   |  |   |                                    |  |
| 17. SECURITY CLASSIFICATION OF REPORT<br>Unclassified  | 18. SECURITY CLASSIFICATION OF THIS PAGE<br>Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT<br>Unclassified         | 20. LIMITATION OF ABSTRACT<br>UL   |  |